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The Business Problems

CONDITIONS in the industry during 1914 and the hopes and prospects for the new year are discussed by authorities of experience and high standing in the articles published in this issue. The foremost of these problems are business rather than engineering in character. From the beginning of the European war the economic effects have borne upon this country, not so heavily as upon other neutral parts of the world but more heavily than many competent judges thought would be possible. Having warded off serious disaster by prompt banking precaution, the country has drifted through five months of the war without that definite improvement in its affairs which is needed for sustained prosperity. The question of what governmental or private constructive policies are necessary to industrial health is the one that demands the earnest consideration of all who have our commercial welfare in mind. Mr. Tripp dwells on the fact that the welfare of home industry and labor depends upon home markets. This diagnosis is wholesome and suggestive. Let us put our own house in order. The governmental authorities, national, state and municipal, can encourage business, and if their attitude is helpful business will meet them more than half-way.

The Rate of Return Changes

SOME of the contributors to the symposium in this issue discuss the effect of the war upon conditions that must influence regulative policies of state commissions. The first conspicuous result of this kind was, of course, the complete change in front of the Interstate Commerce Commission in the steam-railroad rate case. With this stimulus from the leading regulative commission of the country, which had not yielded previously to the arguments for generally higher rates, it is confidently to be expected that state commissions will show enlightenment. Mr. Guernsey speaks of the plain fact that the cost of service includes the cost of capital and that the cost of capital will be higher in the future. Because many of the state commissioners have not had experience in financing or even in commercial borrowing they do not realize the profound truth that supply and demand regulate money rates, that money is a commodity which flows to the best and safest market, and that in order to get money in times of scarcity it is necessary to bid higher than other borrowers. Conservation of capital is of world-wide importance. Natural demands will be increased by the abnormal demands for reconstruction in Europe as soon as destruction shall have ceased. Ample supplies of capital for needed extensions of public utilities will be secured only by the promise of rates of return that are better than the rates obtainable in other channels of investment involving equal risk of principal. That the conditions of supply and demand will undergo changes for the entire world is a consideration which commissioners eager to encourage development will not ignore.

Dissatisfaction with Public Service Commissions

JUST as the principle of regulation is becoming established and almost all of the states have provided themselves with public service commissions, there are murmurings of discontent with some of the existing regulatory bodies. In New York, Ohio, Indiana, Idaho and other states the rulings of the commissions evidently are not drastic enough to suit, or what is still worse the commissions may have become the playthings of politicians while still in their infancy. This is regrettable because an excellent principle is made to suffer by reason of abuse. A vast amount of costly detail work performed by commissions is unknown to the general public, work which is not spectacular in its nature and which cannot be staged in a way to impress the average man. Moreover, in its efforts to remedy evils and effect reforms the public becomes impatient at delays and unreasonable at times in its demands. Reasonable or unreasonable, however, there is no escape from public wrath once it gains momentum, and creatures of the public must stand or fall by public whims. Weak commissions have no reason for existence. They are dangerous alike to the public and to the utilities, and if the principle of regulation is jeopardized because of them, the sooner they are replaced the better it will be for the industries of the country.

Letting the Public Know

THE suggestion of President Scott of the National Electric Light Association that there is a work to be done in leading people to understand the value of electrical service has excellent possibilities. In his article on the constructive work before the association, published elsewhere in this issue, Mr. Scott says that the public does not know that, while everything else has gone up in price, central stations are giving much more in service than they did and that their prices are lower, although their costs of labor, materials and capital are higher. One reason why many people do not realize this is that it has never been told to them. It is the idea of Mr. Scott that Class A members should make it their duty to explain the facts to the public. This is

a much-needed work. If it is not done from within the industry, it will never be done from without. If those who are responsible for furnishing the service cannot testify to the indespensable value of it, they will find that the world is too busy to do anything else than take what they furnish as a matter of course without any thought of its real value. The community interest in prosperity for the central station can be strengthened by the policy outlined by Mr. Scott. The proposal to inaugurate a movement at the 1915 convention is a most hopeful expression of a desire to bring the public in closer contact with the business aims and accomplishments of the central station.

A Noteworthy Transmission System

The plant of the Chile Exploration Company described by Mr. P. H. Thomas in this issue is noteworthy on account of the unusual character of the installation and the service it will be called upon to perform. The mines of the company are situated high up on the Andes at an elevation of between 9000 ft. and 10,000 ft., the range lying within 100 miles of the sea. The territory is in northern Chile toward the northern end of the nitrate district, in a country that is desert from the sea to the mountains. The mines contain immense quantities of low-grade copper ore which is readily treated by electrolysis and is of a character to yield a particularly pure product when thus treated. Fuel at the mines is commercially unattainable.

There being no available water-powers within reach, the transmission plant is one of the few long-distance systems receiving energy from steam power, in this case at the sea, where fuel oil can be obtained at a reasonable price. The seacoast point chosen for the plant was Tocopilla, and the generating station erected there has an equipment rating of 40,000 kva in four 10,000-kva turbo-generator units, delivering energy at 5000 volts and fifty cycles. Pressure is stepped up to 110,000 volts for transmitting the energy over a suitable tower line across the desert to the mines, where are seven 2500-kw motor-generator sets, three with synchronous motors and four with induction motors.

The transmission line, with which we are chiefly concerned, is somewhat out of the ordinary in design. Use is made of galvanized-steel towers spaced about eight to the mile and designed to carry the three wires in a horizontal plane. As compared with the usual standard types employed in this country, the towers are stubby and wide, being only 47 ft. in height to the ground wire, while the base of the tower is 13 ft. by 16 ft. The spacing of these wires 12 ft. 11 in. apart is much wider than is usual in such work. The advantage of the construction is its great mechanical solidity, which is more than usually necessary on account of the high winds which sometimes sweep over the mountainous desert country. On the other hand, the low position of the wires is unobjectionable, because there is nothing to fall across the wires, and no risk would be avoided by increasing the height of the lines.

Use is made of insulators of the suspension type with seven two-part disk units. Arcing horns to protect the conductor and lowest disk are fitted to each cable clamp. To insure continuity of service the insulators have had the most rigorous series of tests of which we have yet heard. Every shell and each cemented disk when completed was tested up to the flash-over point, and the flash-over was continued as a stream of sparks for half a minute. Barely more than 2 per cent of the completed units broke down under this severe treatment. Moreover, puncture tests under oil were carried out, on insulators that had withstood other tests, in order to detect any serious want of uniformity in the product, and every unit was subjected for five seconds to mechanical strain 10 per cent above that expected in service. Finally, completed insulators were strained until broken. The mechanical factor of safety was between four and five. In addition to all these, a heavy condenser discharge under a transformer emf of 300,000 volts was repeatedly thrown across sample insulators to afford an idea of their performance with transient discharges such as accompany minor disturbances from lightning. Under all these tests the insulators held up well, evidence enough of their skilful design and good construction.

Testing Cables in Service by Direct Current

The use of high-tension underground cables in city distribution networks calls for the testing of such cables for acceptance. At the same time, such tests are difficult to make, except on very short cables, owing not only to the high voltage which has to be used but also to the powerful charging currents which the testing apparatus is called upon to deliver. On overhead aerial lines the charging currents and high voltages encountered in present long-distance energy transmission are not so serious as to handicap the alternating-current system by comparison with the direct-current system, which has troubles of its own to meet when high voltages are employed. But in the case of long underground cables the handicap of the alternating-current system may become serious. If in the future high-tension direct-current transmission systems come into use, the incentive for the change will probably arise from the needs of the transmission cables.

In a recent number of the *Elektrotechnische Zeitschrift* an article, referred to in this week's Digest, was contributed on the question by Dr. Lichtenstein. The author showed that by the use of a synchronous rectifier, operated in a testing wagon, with a high-tension alternating-current transformer, it becomes possible to apply a suitable testing voltage to a fairly long cable after laying, without any of the difficulties from reactive current and power which beset the use of the corresponding alternating-current test. In order to employ a suitable direct-current testing voltage, equivalent in its dielectric stress to an alternating-current testing voltage 50 per cent in excess of the working voltage, it is necessary to use three and nine-tenths times the root-mean-square working voltage.

American Electrical Industries in 1914

By T. C. Martin*

A STEADY and in many respects a notable advance was made in the restoration of American electrical industries in 1913 to the active and progressive conditions that had prevailed up to 1907; and all counted gladly on a full measure of prosperity for 1914 that should mark the completion of the period of seven lean years. It was little anticipated that before half of the now-expired year had run the largest part of Europe, and incidentally the largest part of the rest of the world, would be plunged into war. It is some consolation to know that amid these cataclysms industries survive and can exhibit even some measure of growth.

It will be admitted that under the existing circumstances it is well-nigh, if not quite, impossible to present figures and estimates that will correctly portray the real outcome of 1914. One-half of the year was brightened by growing sunshine; the second half has been thrown into the blackest gloom, and he who can find the resultant curve at this moment must be the Prophet himself and not his son. The great monumental fact confronting any economic student is that the electrical industries of America have needed and will need millions of dollars every week for their legitimate and automatic expansion. It is has been a small sum perhaps, compared with the horrid, crazy waste of war, but the trouble is that while a bankrupt nation can still put up a fight for destruction with an empty treasury, a constructive corporation has to quit unless it can pay its bills for labor and material. This should be one of the great underlying arguments against government ownership.

United States Census Returns

In reaching some fairly accurate statistics for 1914, we are assisted by having available in several instances the returns of the United States Bureau of the Census for 1912. Thus, for electric street railways in that year a total gross income was reported of no less than $586,000,000. This, however, does not include electrical operation on main lines or in their suburban territory, so that the figure given in these columns in January, 1913, for the whole —$625,000,000—would appear to be remarkably near the mark. A rate of 8 per cent growth since 1912 would give about $730,000,000 for 1914, and it is believed that this is well within the range of plausibility. It cannot be far wrong.

The central-station figures are somewhat more difficult to arrive at with reasonable approximation. An average rate of increase has been maintained for years far in excess of normal American rates, and the push and punch of the industry, aided by its growing diversity-factor, have yielded remarkable results. It would seem to stand to reason that an industry so interwoven with all others would feel the pressure of bad times. The fact is that it naturally does, but by no means so strongly as might be expected. Over the whole industry an average gain in gross of from 15 to 20 per cent per annum has been maintained. From 1907 to 1912 the total income rose from $175,000,000 to $302,000,000. We get, therefore, somewhere around $400,000,000 for 1914, not so much as was predicted, but undoubtedly it bulks up near the real figure.

Telephone figures are also very difficult to arrive at owing to the perplexing complication introduced by the existence of "independent" systems in various parts of the country. The Bell system reported in 1913 gross earnings of $215,572,000, and it is understood that while it gained in that year some 8 per cent over 1912, the gain in 1913 was only 5 per cent. That, however, was worth while in such a frightfully "off" year. Assuming that the Bell system has more than a good half of the whole telephone business of the country as evidenced by other figures—in 1912 74 per cent of the wire mileage and 58.3 per cent of the telephones—a total of $350,000,000 for 1914 would seem moderate, especially as it is the same estimate as was made in these columns for 1913.

Electrical Manufacturing Statistics

As to electrical manufacturing, a United States census is now in progress under the five-year period system, but probably no true figures will be available from it for a year. The total for the last census year, 1909, was $221,000,000, leaving out many items that are really electrical in their nature, and the rate of growth per annum was then shown to be 10 per cent. Evidently the lowest total to be considered would work out at around $375,000,000, while a more comprehensive estimate, including many branches of work not contained in the government returns, would justify a total of $450,000,000.

Along the lines thus suggested, and subject to the closer study and checking of anyone interested, a table may be drawn up as follows as to the total expenditure in the United States on electricity in 1914:

GROSS INCOME, ELECTRICAL INDUSTRIES 1914

Electrical manufacturing	$450,000,000
Electric railways	730,000,000
Central stations	400,000,000
Telephone service	350,000,000
Telegraph service	85,000,000
Isolated plants	125,000,000
Miscellaneous	125,000,000
Total	$2,265,000,000

This is only about $100,000,000 more than the total gross estimate given in these pages in January last for 1913. The figures cannot be much out of the way. They have been checked up from a great abundance of data and from the views and opinions of many different authorities. At one point they may be somewhat high and at another rather low. Taken *en bloc* the writer is ready to stand by them, and it is a source of pleasure and pride to him to note that on the average they show every living soul in these United States to be spending voluntarily about $20 per annum for electrical materials and service, of which he would not spend a single cent if he did not benefit thereby.

The growth in population would thus seem to afford some measure of the increase in electrical service and in the use of energy from the circuits, or in the consumption of material. This may be relatively true, but a number of disturbing factors come into play, and it is never quite certain what the population is from year to year. Moreover, the calculation is governed to a great extent by the fact that hitherto the commercial development of electricity has been based very largely upon an abnormal growth in the urban population. This tendency has not declined but still shows intensification. On the other hand, one of the most notable social and economic changes of the last few years is that due to the extension of electrical service of every kind to rural districts, and this condition has by no means yet reached its fullest manifestation. In fact, it may be said to have barely begun. Hence the population electrically considered is a much larger percentage of the total population each year.

*Secretary National Electric Light Association.

Applied Electrical Science in 1914

By A. E. Kennelly*

THE year 1914 will undoubtedly be signalized in the history of our world by two great epoch-making events, namely, the opening of the Panama Canal and the opening of the worldwide war. Both events may be classified as relating to engineering or applied science, the one being an engineering event of international constructiveness and the other an engineering event of international destructiveness. Both have distinct relations to electrical engineering, and both are doubtless destined to leave their impress upon human affairs for many generations. Nevertheless, we may well hope that, in the long run, the constructive effects of the canal upon international activities will outweigh the destructive effects of the war.

Influence of the Panama Canal

The influences of the Panama Canal are manifestly destined to be more potent on civilization than those of the Suez Canal because, to use an electrical analogy, the route short-circuited is greater. The Cape of Good Hope lies approximately in south latitude 35 deg., whereas the Magellan Straits lie in south latitude 53 deg. By means of the new short-circuit the whole world is virtually made smaller and the nations of the Pacific are brought into greater relative prominence. Electrical machinery and long-distance electrical control, with their concomitant modes of thought, not only actuate the locks of Gatun but will carry their stimulating influences to all parts of the Pacific. The center of gravity of the world's engineering activities must necessarily undergo some displacement.

The War's Effect on Electrical Engineering

The war has already exercised notable effects upon electrical science. On research, pioneer investigation and all that goes to pave the way for advancing engineering knowledge it has laid a heavy hand of repression, many young men having been taken from the laboratories of Europe to trenches, fortifications and graves. The influence of this setback is likely to be felt in scientific research for many years to come.

On the other hand, the war itself has had a remarkable influence upon particular branches of electrical engineering, and notably on radiotelegraph engineering. This has been stimulated by the needs of maintaining communication between co-operating forces separated by considerable distances, especially as submarine cables have been intentionally cut in a number of places. Hostile cruisers have commandeered and erected radio stations, while they have also been captured by means of notices sent out through other radio stations. For the first time in the world's history we have witnessed the regular use of radio transmission across the Atlantic, by one of the belligerent powers, for the dissemination of daily war bulletins. Radio communication has also been employed in the field along the astonishingly long lines running over hundreds of kilometers, while aeroplanes have also been equipped radiotelegraphically. Battle fleets have kept their ships in touch with radio signals, and "jamming" between hostile signalers is now recognized as a regular weapon in the new ethereal warfare. The whole war has depended upon engineering as never before.

This is a petrol war, in which transportation to the armies in the field beyond rail-head has depended vitally on automobiles, advances of troops on the ranges of the most improved type of rapid-fire cannon, and naval contests on the results of shooting at distances not less than 6 km. It is manifest that next to discipline and morale engineering is most important in war.

Another instance of the stimulus which war may give to engineering is afforded by the decision which has been recently announced in the press that, in view of the satisfactory experience last year with the electromagnetic drive on the United States naval collier *Jupiter*, the United States Navy Department intends to try electromagnetic variable-speed drive between steam turbines and propellers on a new battleship. On such a ship the demand for high fuel economy over a wide range of speeds is particularly great. Nevertheless, if the electromagnetic drive proves very satisfactory on warships, it may be possible to extend its application to commercial vessels.

Immense Field for Electromagnetic Research Opening Up

Turning to more tranquil themes, the year just passed has witnessed a remarkable development in the electronic theory of the atom. It is only about two years since Dr. Laue discovered the remarkable effects of the interference of Roentgen rays passing through thin crystal plates. This discovery appears to have set ajar the door of a new world, which many pioneers such as Moseley and Bragg are rapidly opening.

The world of our immediate recognition may perhaps be described as commencing with the linear magnitudes revealed by the ordinary microscope and ending with the linear dimensions of the earth's diameter, a range in round numbers from a micron or meter-sixth up to some 10,000 km, or a meter-seven, a total range of ten million millions. Beyond this we recognize a telescopically revealed world of upper magnitudes commencing, say, at a meter-seven and going up to what limit we know not, but employing measures of decades of light-years, and light is supposed to travel in one of our years through nearly ten millions of millions of kilometers, or a meter-thirteen; so that the upper magnitude world may be estimated in round numbers as from a meter-seven to a meter-fifteen, or through an explored range of about one hundred million. There is now opened to our comprehension a third and lower-magnitude world, commencing, say, at a micron, where the ordinary microscope stops, owing to the relative coarseness of light waves, and descending to we know not what lower limit, but already it is said to an infinitesimal part of a micron; that is, to the X-ray wavelength. The world of our immediate cognizance thus comes between an upper-magnitude telescopic world, with no known upper limit, and the new lower-magnitude X-ray microscope world or under world, with no known lower limit. The under world is also an electrical world in the sense that its dynamics and modes of exploration are essentially electromagnetic. Already the explorers in the under world are explaining to us, from the results of their measurements, some of the mysteries of crystalline structure and holding out possibilities as to the yet deeper mysteries of atomic structure. An immense field for electromagnetic research seems to be opening on the borderland between ours and the under world as the result of discoveries during 1914.

While notable progress has been made in the investigation of extremely short electric waves, progress has also been made during 1914 at the other end of the spectrum, or in the extremely long electric waves of long-distance radiotelegraphy. Ranges, powers and

*Professor of electrical engineering, Harvard University.

wave-lengths have all been advancing. Moreover, marked advances have been made in the construction of very high-frequency machines for radio communication. It would seem as though the progress of engineering in long-distance radiotelegraphy called for the design of exciters of sustained oscillations in the sending antenna, as distinguished from exciters of oscillations in separate groups.

Steady progress has been witnessed during the year in the direction of the manipulation, control and knowledge of high-tension phenomena in relation to transmission lines, including corona losses and over-voltages. Energy-transmission lines have increased in voltage, number and length.

Applied Science of Illumination

In the applied science of illumination, there has been a tendency to increase the use of the lumen or unit of luminous flux and to diminish the use of the candle or unit of luminous intensity. The tendency has been fostered by the difficulty which presents itself in the photometric measurements of certain new types of lamp, in which the zonal distribution of light is more than ordinarily complex. In so far as the tendency is parallel to similar movements in the past development of electrics and magnetics, it is presumably to be regarded as an advance.

In the direction of standardization of electrical machinery the publication by the American Institute of Electrical Engineers of a new edition of its Standardization Rules constitutes a distinct step in advance. The new edition is not only a great improvement upon the old but it also covers much more ground, owing to the collaboration of many specialists in the various branches of electrical engineering. The new rules have not only presented a fine series of technical definitions, but they also abolish the antiquated preceding notion of an overload capability to be expected in electrical machinery, like a bonus on a stock transaction. The new order of ideas in regard to thermal rating allows of no overloads in regard to temperature, but it establishes clearly the principle that each and every type of electrical machine inherently possesses a certain hottest-spot temperature that should not be exceeded if the particular insulating material entering into the machine is to be preserved from injury. Consistently with maintaining this limit of temperature, the capability of the machine to carry load depends upon the temperature of the machine and the cooling powers of its environment so that in winter weather, with low surrounding temperatures, a machine may be capable of carrying considerably more load than in a hot engine room or at a summer temperature. Under specified conditions of ambient temperature the rated load may be obtained.

Constructive Work Before the N. E. L. A.

By Holton H. Scott*

THE National Electric Light Association is a co-operative body and its operations cover a very wide field. Its membership embraces practically all central-station companies in cities of 10,000 or more in the United States and Canada and in addition many companies in cities of less than 10,000. Its proceedings and reports are a minute history of the development of the electrical business. The committee reports have established the latest authoritative standards in approved, suggested or recommended practice, as, for example, in the classification of accounts, overhead-line construction, meter work, rules for resuscitation from shock, and the formulation of rules for accident prevention. The public policy committee deals with a wide range of subjects such as the relations with public service commissions, national departments of the government, state boards and bureaus, relations with the public, and relations with employees in regard to such matters as pensions, sick and accident relief and profit sharing.

Last year a new committee, namely, the educational committee, was created to bring about closer relations between our industry and the technical universities and colleges. This is important because from 30 per cent to 50 per cent of the graduates of the electrical engineering courses enter the central-station field and heretofore no effort has been made by the association to suggest possible ways to make the courses more valuable. The committee will also arrange to have leaders of the industry make addresses from time to time before the larger universities, and it is hoped that this will result in much good.

Our association has the means of reaching more people than any other body because each month a representative of our Class A members comes in contact one or more times with a property owner or a renter of property. The total number of consumers of our company members forms a list that would be considered a valuable asset by a mail-order house or bond house.

It will be the aim of the present administration to formulate a plan which will stimulate our Class A members to teach their consumers something about the value of electrical service. This is the biggest constructive thing we can do because it is the inability of most of the public utility companies always to finance themselves that prevents the more rapid development of electric sales. Much has been said about the duty of the public service corporation to the public, but too little has been said about the duty of the public to the public service corporation. The public does not know that, notwithstanding the fact that practically everything else has been going up in price and notwithstanding the fact that we are paying more for our raw materials, for labor and for capital, we are literally giving three times as much for a dollar as we were fifteen years ago, to say nothing about the wonderful improvement in service in other ways. The public could not have possibly forced by legislation any reductions in rates which would have been the equivalent of the benefits it has derived from the installation of more efficient energy generating and consuming apparatus.

Need of Public Understanding of Problems

If the electric industry is to grow in the future as rapidly as it has in the past, the public must be taught that central stations are not selling a commodity, they are not selling kilowatt-hours, but they are selling a service. The public, or at least a portion of it, must be made to understand that the passage of drastic legislation and the hampering of the legitimate operations of central stations only makes it harder for the company to finance itself and makes it harder for the company to serve its community properly.

If the N. E. L. A. can in a proper way through its Class A members cause that portion of the public to see matters in their true light, it will have accomplished a wonderful work. The writer has asked all the Class A

*President National Electric Light Association.

members to give this matter of service serious thought and has invited suggestions, and it is the intention to devote considerable time at the 1915 convention to this broad question.

The San Francisco Convention

Our 1915 convention will be held at San Francisco from June 7 to 11, and arrangements for the meetings are well in hand. The transportation committee has already practically settled on the itineraries of the special trains, and the local hotel committee in San Francisco has been at work for several months. Mr. John A. Britton, who was a recent visitor in New York, promises that, notwithstanding the fact that it is the exposition year, the delegates to the convention will be well taken care of. He also expresses the belief that all visitors to the exposition will be agreeably surprised at the beauty, completeness and magnitude of the grounds and buildings, and we therefore hope to have a very large attendance. Notwithstanding the distance many will have to travel, this opportunity to visit the Pacific Coast will meet a widespread acceptance.

Outlook for Central Stations in Pacific Northwest

By O. B. Coldwell*

THE growth and development of practically all lines of industry in the Pacific Northwest during the decade ended with the year 1912 were without precedent.

Throughout this period there was an increase in the demand for central-station service, which in some communities in individual years was as high as 30 per cent, the increase during the decade being such as to require the enlargement of the electrical facilities about fivefold. Those who were employed in central-station work in this section of the country were engaged busily in an endeavor to keep abreast of the rapidly increasing demands upon generating plants, transmission lines, substations and distributing facilities which come into play in rendering electric service. The class of service given by the central station in 1902 was not so good in quality as is expected and furnished to-day. Hand in hand with the expansion of facilities there were carried out comprehensive plans for improving the quality of the service. This has resulted in the elimination of much of the apparatus of older types and the substitution therefor, at large expense, of new and more efficient machinery, together with amplification of transmission and distributing facilities.

Extension of Central-Station Lines

During this period central stations have extended their lines into many new communities and have thereby been instrumental in bringing about a more rapid development of the country. This is especially noticeable in the expansion of the central-station systems operating in eastern Washington, Oregon and certain sections of Idaho. Many rural communities in these States have actually been put on the map by the coming of the electric supply lines of central-station systems. Electrical energy has entered into and become a part of rural life and is ever finding a wider application. It is unnecessary to cite all of the various farm operations which are now taken care of easily and readily by electrical energy. Activity along these lines will continue.

At the time many of these extensions were made the business in the communities to be served was hardly sufficient to justify the expenditures necessary to carry out the construction work, but, having faith in the ultimate outcome and appreciating their obligations as public utilities, the central-station interests in the Northwest have done their full duty in this very important work of helping to upbuild the communities.

Water-power plants are the common source of power of central-station systems in this region, steam plants being used as a general rule for only relay and emergency service. We are blessed with an abundance of streams which fall rapidly in their course, and while the figures usually quoted about the quantity of power available represent what might be called the extreme ultimate potential possibilities, there is, even on the basis of present-day economic conditions, an abundance of water-power projects available for feasible commercial development.

Time Needed to Develop Hydroelectric Projects

It takes time, possibly one and one-half to three years, to develop one of these water-power sites and build transmission lines from the hydroelectric plant into communities where the market is located. It is essential, therefore, that central-station interests anticipate their requirements a sufficient time in advance so that the new plants may be built and ready by the time they are demanded.

At the end of the above-mentioned decade of unusual activity at a time when economic conditions the world over were such that business was beginning to be affected, the companies in the Northwest, in many instances, with due regard for the demand which previous growth had led them confidently to expect, had entered upon the construction of additional facilities in generating plants, transmission lines, etc. With the completion of these additional facilities in 1913, there was something of a let-up in business and a resultant decrease in the demand for central-station service. The result is that the central-station systems in the Northwest find themselves with facilities somewhat in excess of immediate needs, and they are, therefore, in an excellent position to take care of new business in the near future, to which all are looking forward.

Increased Population for Future Development

It is generally appreciated in the Pacific Northwest that our greatest need for future development is an increased population. We are ambitious to attract more people to come here. Above all we desire the industrious farmer to help us introduce more intensive farming methods.

The Pacific Northwest abounds in undeveloped natural resources, which, through the opening of the Panama Canal, are over 5000 miles nearer the markets of the world. With the demand for manufactured products which has already started and which will doubtless grow to large proportions as the result of the European war, these natural resources are bound to be an important factor. Having unbounded faith that with the coming of the year 1915 there will be an increased demand for electric service, the central stations of the Pacific Northwest extend a cordial welcome to the home builder, the farmer and the manufacturer to come into our community and grow up with us. We have demonstrated in the past our ability to take care of any reasonable demand for service, and our policy for the future will be to extend our systems in such a way as to take care properly of increased loads as they materialize.

*President Northwest Electric Light & Power Association.

New England Central Stations and the War

By Howard T. Sands*

THE declaration of war in Europe in the midsummer carried to America a feeling of uncertainty regarding the effect upon business which can never be measured. The faith of the central-station industry in the fundamental stability of electric service, however, has been justified by the experiences of the last five months, and unless developments in international affairs not now apprehended arise, there is every reason to believe that 1915 will bring increased prosperity to electric light and power companies in this country, particularly to operating organizations which enjoy or are in a position to cultivate a diversified load.

Varied Industries Served

Many New England central stations supply energy to communities of varied industries. Such cities and towns have felt the effects of the war much less than municipalities dependent upon a single large industry. The supply of electrical energy means so much to the general public that as a rule even the shock of hard times has failed to prevent growth of service, although progress would be faster with more favorable conditions in the business world. In the Tenney companies in New England the number of new electric meters set since Aug. 1, 1914, has increased 2 per cent over the number placed in service in the period between Aug. 1 and Dec. 1, 1913, and there has been no decrease in the average of kilowatt-hours used per meter in service. Since the war began our New England companies have gained some 1500 new customers, and in some instances the October and November gains were greater than at any previous time in the history of the individual organizations reporting to the headquarters office.

The economies of electric drive are winning recognition in all branches of industry. Manufacturers who seek to reduce expenses and increase output per machine are turning to central-station service with an interest heightened by present business conditions, and in the lighting and appliance fields the popularity of electrical energy has continued to increase practically without reference to conditions in many other lines of industry. Between Aug. 1 and Dec. 1, 1914, these companies connected 1872 hp in new motor business. Sales departments have been remarkably successful in extending service in the most varied fields.

Few persons outside of the central-station industry and allied activities realize the extent to which electric service pervades modern affairs, and even many who are within the field of electrical supply fail to appreciate the great opportunities for further development. A study of diversity factors in different industries and in the field of appliance service and commercial lighting shows that the eventual date on which a growing and live community can be considered electrically saturated cannot be predicted. Within the last few years the price of electrical energy has been generally reduced, and this, combined with decreasing cost of appliances because of production on a larger scale, special campaigns and better adaptability to the needs of the average man and woman, is contributing powerfully toward the enduring success of the industry.

Electrical merchandising is more prominent than ever before, and in the motor-service field the savings in net operating cost per unit of product are, with the other advantages of the electric drive, responsible for the steady expansion of this class of service toward limits that cannot be foreseen.

A Good Showing Despite Adverse Conditions

The rapid advance of electrical energy as a necessity of modern life, which has enabled the companies to make a good showing despite almost unparalleled external adverse conditions, will be continued in the new year with beneficial results to public and investor alike. It would be futile to claim that a business depression has little effect upon the electrical industry, but, so far as New England is concerned, that effect has been rather to restrict extensive new construction in industrial fields offering a wider market for service than to curtail expansion of central-station loads in existing enterprises. That the industry has shown a positive growth under the conditions of the last five months ought to encourage everyone's faith in the outlook for the future.

The Electrical Year in Canada

By Alan Sullivan†

IN Canada the sale of electrical energy proceeded in an entirely satisfactory way until the latter part of the year, when business became affected generally by the war. Until that time progress had been excellent. At the end of July one of the largest corporations reported a yearly increase of 15 per cent in energy sold. The same corporation reported later that the amount of its October, 1914, business was identical with that for the same month in the previous year.

Since August, however, both manufacturers and private individuals have decreased materially their consumption of energy. Merchants are displaying unusual economy in lighting their shops and citizens have reduced their entertaining to a minimum, with the result that the revenues of electricity-supply corporations have been reduced.

The business of the privately owned light and power companies has been handicapped further by competition with municipally owned enterprises, which pay neither taxes nor dividends. This peculiar governmental competition has had a deterrent effect upon the investment of foreign capital. This influence and the current tightness of money mean a double burden upon private enterprise. The light and power companies of Canada are making every effort to secure public recognition of the fact that they should have conditions of at least equality with those of their rivals for business.

As tending to offset these difficulties there has been evolved a type of management unsurpassed in efficiency and in practical interpretation of the essential meaning of "service." In fact, it might be stated that the service given by privately owned companies in Canada has secured and will continue to hold for them the most profitable business in their communities.

The report of the Department of Inland Revenue for the year ended March 31, 1914, indicates that six of the largest hydraulic generating stations produced over 1,500,000,000 kw-hr., of which about one-half was for

*General manager Charles H. Tenney & Company, Boston, Mass.
†Secretary-treasurer Canadian Electrical Association.

export. Out of 128,471 electric meters tested by the government, only 224 were rejected. This is an excellent showing.

Business on the Pacific Coast has been about the same as in the East. A few manufacturers are working double shift on foreign and domestic war orders, but most have curtailed their activities.

Notable New Development

New development of note has been confined practically to that of the Cedars Rapids Company, on the St. Lawrence River above Montreal. Here the ultimate output will be 180,000 hp. It was expected that the first units would be in operation by January, 1915, and they have, in fact, already been completed. The Electrical Development Company, now controlled by the Toronto Power Company, has installed two additional generators, yielding about 20,000 kw.

Owing to the unprecedented lowness of water during 1914 many hydraulic plants on northern rivers have been short of power. This result is attributable largely to the lack of adequate snowfall during the preceding winter and to an exceptionally scanty rainfall. This combination has made costs of generation more than usually high for the companies affected. In western Ontario, however, electrical energy is being developed by gas engines supplied by natural gas at a cost of $14 per kw-year. It is difficult to see how energy transmitted 180 miles from Niagara at a cost of $32 per kw-year can compete under these circumstances. Yet this is what certain municipalities are attempting to do in the purchase of energy from the Hydro-Electric Power Commission of Ontario.

Co-operative Movement

All through Canada there has been a movement on the part of privately owned companies to co-operate. Thus a system of co-operative purchasing of electrical supplies is about to be established, by means of which not only a high standard and a thoroughly standardized article but also a low price which will benefit directly the ultimate consumer, the man in the street, will be secured. This will comprise part of the work of the members of the Canadian Electrical Association for the coming year.

The association, through the close watch which it keeps on legislation that may affect privately owned companies, was successful in securing a reduction of 50 per cent in the proposed amount of the corporation tax in the act passed recently by the Ontario government. As is generally known, the association is a sister organization of the National Electric Light Association, with which it is in affiliation. Col. D. R. Street, secretary-treasurer of the Ottawa Electric Company, is president. The membership extends across the continent.

The Electrical Industry in England in 1914

By Haydn Harrison*

GREAT BRITAIN has now been at war since August, and it is a proof of the importance of the electrical industry that our factories are as full as ever of electrical work of all descriptions, while those which are provided with suitable tools are working day and night to produce the seemingly endless list of electrical and mechanical contrivances needed in modern warfare.

The perfecting of manufacturing methods which has been carried out by those producing electrical machinery has naturally led to these works being particularly efficient for rapid production of war materials. Thus many of our works now present an altered appearance. In place of stocks of electric motor covers, piles of projectile cases are to be seen, and accurate machines which in times of peace were turning out parts of electrical appliances are now rotating day by day grinding out essential parts of engines of war.

The War and Electrical Workers

When Lord Kitchener decided that it would be necessary for this country to prepare millions of men for the fighting line recruits came forward from all classes and trades; but it soon became obvious that volunteers taken from engineering workshops would seriously affect the supply of war materials; or, in other words, that a mechanic working at the lathe or the bench, doing his share in the production of war electrical or other machinery, was of more value to the country than the same mechanic behind a rifle at the front. Thus volunteers from this source are now being thanked for their exceptional readiness in coming forward but are asked to remain at their posts in the workshops. This shows how important the electrical industry is in the protection of a country, and it must be a great satisfaction to the readers of this journal to know how well provided for America is in this respect, on account of the efficiency of her engineering workshops and factories and the men who work in them. To all engineers it cannot fail to be gratifying to know that the importance of their industry will be more than ever realized by the world at large.

Growth of the Industry

In order to appreciate the growth of the electrical industry in Great Britain during 1913-1914 it is only necessary to note the increase in capital invested, namely from £435,100,000 to £458,700,000, or by £23,600,000. In the previous similar period the increase was under £12,000,000, and it is therefore obvious that considerable development has taken place.

This increase is partly accounted for by the steps taken by the main-line railways to electrify such of their systems as are devoted to carrying the millions of daily workers backward and forward to London. This can hardly be called suburban traffic since, for example, the London & North Western Railway is in process of electrifying its line as far as Watford, 18 miles from the city. The London & South Western Railway is similarly occupied in connecting the riverside residential districts. The success of electric traction on the London, Brighton & South Coast Railway has no doubt led to the others following suit; but, despite this success, it is noticeable that neither of the other lines mentioned has adopted the same system, namely, high-tension single-phase with stationary transformers on the trains. They have preferred to use substations and transform the high-tension supply from the generating stations to direct current at 500 volts, using conductor rails in place of an overhead conductor.

With the exception of the Brighton line, the railways are putting up their own generating stations. This policy, at a time when bulk supply schemes are receiving so much favorable consideration, must appear to many as incomprehensible. It can only be concluded that difficulties of interconnection between the various companies must have arisen.

A further source of increase to the electrical indus-

*Electrical engineer, London, England.

try is the more general use of electric drives in factories and workshops. This is especially noticeable in the manufacturing districts, where the lighting load is becoming relatively insignificant.

The effect of the reduction in output due to the introduction of the tungsten lamp is now being compensated for by the large increase in lighting consumers and also by the demand for improved lighting. However, the high cost of installing electric circuits is still largely preventing the use of electricity among the lower middle classes. The result is that municipalities owning electricity undertakings are awakening to the advantage to be gained by obtaining the right to borrow money to wire premises and install fittings on the hire or hire-purchase basis, as their competitors, the gas companies, having such rights, are to a large extent able to hold their position among the less wealthy classes by virtue of them.

Progress of Electric Cooking

This remark applies particularly to electric cooking, which is now beginning to make progress in England. It has been the custom of the gas companies to rent gas cookers and other appliances at such reasonable rates as to allow of their use among all classes down to that of the artisan. In order that electricity may compete in this direction it is evident that a similar policy must be adopted.

To encourage electric cooking many of the supply companies now charge 0.5d. per kw-hr. plus a small charge on the ratable value of the house, or, as an alternative, a minimum charge. At these rates there is no doubt that the cost of electric cooking and heating compares favorably with, and is in many cases less than, that of gas, but the cost of the appliances and wiring still bars the way to its general adoption.

The supply of electricity to small towns and villages is receiving more attention owing to the prejudice against overhead mains being slowly but surely overcome. This branch will soon represent an important field of development, as small gas companies are not in a position to work economically and cannot compete with electricity generated by means of internal-combustion engines. The number of such towns in England is very large. Few of these can be reached by bulk supply companies, and in any case small local undertakings are proving a sound financial investment, which, when money is more available for the purpose, will no doubt be sought after by the investing public.

The Nitrogen-Filled Lamp

The advent of the nitrogen-filled lamp has failed to have any appreciable effect for the moment. The production of it in England has only just begun, and its most important field, namely, street lighting, is now receiving little attention on account of the precautions being taken against the enemy's aircraft by reducing the lighting of the streets.

Steps are being taken by the supply undertakings to popularize the electric road vehicles—more particularly the slower-speed delivery vans. This development is progressing slowly, but it is anticipated that by this time next year it will form an appreciable factor in the electrical industry.

At the present moment the government is busy erecting winter quarters for the thousands of men who are being prepared for the fighting line, and it is a sign of the advance of electric lighting that nearly all these camps, temporary as they are, are being lighted throughout by electricity. Many of them are in the very heart of the country, out of reach of any supply, and are therefore being provided with generating plants of their own. Nevertheless, before this article is in print the majority of these camps will be built, drained, heated and lighted throughout, which is in itself an indication that the Britisher can meet an emergency when called upon. The emergency which the British nation is having to meet now cannot fail to awaken those instincts in the individual which lead to rapid developments in the arts of peace. There can be no doubt that the whole world looks forward to an early cessation of war. When this wish is granted, the development of all industries, including our own, will go foward with renewed vigor in this country.

Opportunities for the Central Station in the Electric-Vehicle Industry in 1915

By John F. Gilchrist*

SUBSTANTIAL commercial progress is promised for the electric vehicle during the twelve months to come. Already we have seen the uses of the passenger car broaden until it is finding more and more favor with business and professional men. The recent business depression and consequent personal retrenchment on the part of many of the people have, in the case of the electric automobile, only served to bring out more strongly the latter's advantages and economies in comparison with the gasoline car. Well-to-do business men who formerly owned and used cars of both kinds but have latterly felt it to be the course of prudence to give up the use of one or the other have, almost invariably, retained their electric cars for personal and business purposes. No better testimony than this could be asked for the economy of the electric vehicle—to say nothing of all its obvious advantages of convenience, simplicity, reliability and ease of operation compared with other vehicles.

One of the most important features in the development of the passenger vehicle has been the garage facilities offered owners of electric cars in the larger cities. In comparison the commercial truck has suffered from the lack of such facilities, and if the development of the commercial truck business has latterly fallen short of the optimistic expectations of a few years ago, the fault may be laid, very largely indeed, to this lack of garage facilities.

Greater Charging Facilities Needed

Few garages doing an electric passenger-car business are in suitable locations for handling trucks, nor do they have the charging facilities for supplying the large currents required by the truck batteries. And where the progressive garage man considerately takes the electric truck under his roof he is often confronted with protests from women owners of pleasure vehicles, who declare that they will not have their favorite cars kept alongside delivery wagons, the protesters seeming to fear that damage to their vehicles will ensue.

*President Electric Vehicle Association of America.

On the other hand, the electric truck stabled in a garage with gasoline trucks is placed at a disadvantage from the outset. Not only does it suffer from the absence of experienced attention, but as it sometimes has to withstand the prejudice of the garage "hikers," a poor performance showing is often made to the owner of the truck.

Operated in fleets under experienced supervision, the electric truck has invariably fulfilled the most optimistic promises made by its adherents and has given every satisfaction to its owners. To give the user of one or two trucks the same advantages, it is evident, therefore, that we need more commercial garages, catering exclusively to the electric truck business, and manned with attendants experienced in the care of batteries and electric vehicles.

Possibilities of the Electric Passenger Car

But it is in the development of the electric passenger car that the greatest possibilities seem to lie just ahead. Limiting its usefulness as a man's car, the electric has for years suffered from the handicap of a lack of variety in body design.

In mileage, speed and performance the electric vehicle has long fulfilled all the requirements of that ideal universal utility car which its advocates predict that ultimately it will become. But in designing the bodies along the single line so closely followed thus far the broadest development of the electric car has been seriously trammeled. If the five-passenger arrangement of seats employed on gasoline cars has been proved to be the most useful after fifteen years' experience on hundreds of thousands of automobiles, we should not hesitate to apply a similar design to the battery-driven chassis, even if at the risk of being called imitators of gas-car models.

To repeat, the mileage, speed and economy of the electric vehicle are already highly satisfactory, but we need a more workaday design of body, for the banker, the professional man, the business man and the salesman making city calls properly demand models differing from the luxurious cars which ply the boulevards.

Utility Passenger Cars for Central-Station Work

If a movement which is now receiving some consideration by the Electric Vehicle Association of America be adopted and prove successful, it will open the way for the introduction of practical electric passenger cars of enlarged usefulness in many cities and towns of the country. As the first step it has been proposed that 100 central stations each agree to purchase during 1915 one electric vehicle which may be a standard car or may be of a special design considered particularly serviceable for central-station work by a committee of central-station engineers. Special prices have been obtained for these cars in lots of twenty-five.

With these practical electric passenger cars in use by electric companies scattered over the country, examples would be set for local owners, and, it is believed, there would result a great demand for electric vehicles of a type to replace the present popular two-seated gas-car model, but with all the inherent advantages of electric operation.

Viewing the transportation requirements of the electrical industry for a minute, there certainly appears no reason why any central-station organization in this country should have in its service a single gasoline car, when the electric vehicle is capable of performing every possible class of duty required by the business. An exception may be made, perhaps, in the case of the company doing a suburban business whose men must cover large territories. But even for country-road work the need is for a machine of small size and weight, rather than for one of any particular type of motive power, and thousand-mile tours have already demonstrated the dependability of the electric for the widest variety of road service.

Have the Central Stations Done Their Share?

Although many central-station companies have helped in the work of introducing the electric vehicle, the fact remains that as a whole the central-station industry has not done its share in popularizing the electric automobile. Not only have the central stations failed to push vehicle sales among their customers, being content to sit back and take the vehicle-charging revenues when these have come through the efforts of others, but, as already intimated, the electric companies have ignored their own duty to use themselves the machines they prescribe for others.

This condition has been brought about in part by the lack of confidence of company executives and in part by the prejudice of the men lower down. With thoughts of a Sunday spin in the country, too often the man whose work requires the use of a car during the week very humanly picks his machine with the week-end joy ride in view, rather than the sober requirements of his daily job. These men need training in loyalty to the electrical industry, if, indeed, they are not lacking in knowledge of the possibilities of the electric vehicle. Their superiors also, perhaps, need to know more about the vehicle to give them courage to insist on the use of electric vehicles at all times when such cars can perform the company's service satisfactorily.

An End to Bickering in the Industry

We have been witnesses long enough to the bandying of charges and counter charges between central stations and manufacturers, on the one hand, that vehicles should be sold at lower prices, and on the other that lower rates should be offered for vehicle-charging service. Instead of assuming agreement with the extreme positions of these claimants, let us take the word of each on the operation of his own business and admit, for the sake of the industry, that electric cars of the quality which the makers say the purchasing public demands cannot be built more cheaply than those now offered. Let us also concede that the central station is justified in the rates which it is forced to charge to deliver energy to the private garage. The cost of electricty, like the cost of gasoline, is, after all, but a fraction of the cost of running an automobile. Let us put aside these dissensions within the electric-vehicle industry, and let us silence the carping claims of those who seek to evade responsibility and effort by the familiar process of blaming others.

Co-operation That Will Bring Results

"Co-operation" has been a much-used word in the electrical industry of late—a word dinned into our ears, indeed, until it has almost lost its meaning. But there is a new and real significance in the kind of co-operation which will follow if, while the vehicle maker gives freely to the central station active assistance in the development of the local field, the central-station staff, from executive to salesman and troubleman, will in return specify electric vehicles as the only cars for their work, and thus set an example to the community which they serve. With closer co-operation in this way between vehicle makers and purveyors of energy, and with better garaging facilities for both commerical and passenger cars, the electric vehicle is bound to come to the front and ultimately to serve the general public in an overwhelmingly large proportion of cases calling for the use of a motor-driven conveyance either for business or pleasure.

The Present Industrial Depression

By Guy E. Tripp*

THERE is little difference of opinion about the extent and intensity of the present industrial depression, but there is much about what has caused it.

It is laid at various doors—the war, tariff reduction, "unliquidated" condition of labor, troubles of the railroads, anti-trust legislation, competition, monopolies, and some make up combinations of these to suit themselves.

What follows may be interesting if only for purposes of comparison with other ideas that have been expressed.

The effect of the war on world industrial conditions has been full of surprises. English manufacturing concerns generally are now unusually busy, not alone on war materials but in the production of usual supplies, because English shipping has not been greatly interfered with and manufacturing orders throughout the world that had been given or were about to be given to Germany have been canceled and generally placed in England; and, as a result, strange to say, a greater depression probably exists in the manufacturing industries of the United States than in England.

Shock to Capital Caused by War

The effect of war orders that have been received here has been more than offset by the unparalleled shock to capital and the world-wide disturbance of financial currents and exchanges, the war being a revelation to many of us of the extent to which we are a debtor nation.

This country will probably receive further war orders and to that degree will derive benefit; but should the Allies be victorious the nation that will receive the greatest impetus and permanent business increase will probably be England.

This does not say that our foreign commerce, particularly with South America, cannot be increased; but, in my opinion, the conditions after the war will be substantially what they were before—that is to say, the foundation-stone of American manufactures will be our home market, and anything that weakens it will do damage that will not be offset by any increase that is likely to come in our foreign trade.

We shall still be a debtor nation, and England, if she wins, will still be rich and her ability to do foreign financing practically unimpaired. Her possessions and colonies will tend to trade with the mother country out of patriotic feelings and the rest of the world will be in sympathy with her and largely financed by her. Nor will the situation be much different if Germany wins, for she will probably regain her trade very rapidly.

Therefore, I repeat, the welfare of home industry and labor will depend upon home markets quite as much or more after the war than before. So much for the effect of the war.

One of the important factors in determining our industrial future is the so-called "liquidation" of labor. This is ordinarily understood to mean a reduction in the rate of wages, but there probably will be no permanent reduction in wages.

Variations in wages go hand in hand with the cost of living. Higher wages mean higher costs of production and consequent higher prices for necessities. Another contributing cause to higher wages and cost of living is the lesser intrinsic value of the "yardstick" by which "cost" is measured, namely, the gold dollar.

In the last few years the amount of gold per capita has greatly increased, principally on account of the enormous new output of African mines, and this means that the "yardstick" of exchange has shrunk accordingly.

Another cause contributing to the high cost of living is education and advance in civilization, with the accompanying increasing demands for comforts and luxuries. One other cause contributing in some cases to higher wages, and thus to higher cost of living, is the arbitrary raise demanded by labor unions.

If, as a result of any of these factors, wages are relatively too high and cannot be reduced, and the cost of living cannot be readjusted in any great degree, it seems obvious that the effect can be offset only by a reduced return to capital or increased prices or greater efficiency of labor.

An increase in prices would have a temporary effect, but that again would increase the cost of living. Whether or not this would, in turn, tend to increase wages would depend largely upon business activity and the supply of labor available to meet the demand.

Speeding up machines and other devices to get more work out of employees, while it may in effect temporarily reduce wages, creates unrest and does not permanently increase the efficiency of the man. His efficiency can be increased only when he is willing to have it increased, and human nature is such that he must be offered a reward before he is willing, which means that a portion of the savings effected through extra exertion or care must be given to the workmen. A great deal is now being done in that direction by manufacturing concerns, and the more progressive employers in other industries are adopting the theory more and more.

A concrete case is that of an electric-light company whose manager, as an illustration of his methods, described recently how he had fixed a standard for reading meters. He adopted the simple method of multiplying the number of meters read by the standard price and deducting the meter readers' payroll from the sum, dividing the difference between the company and the meter readers, with the result that for several years (although his business has increased at a normal rate) it has not been necessary to employ any new men in this department. That is real efficiency work and the only light that I see in the direction of permanently "liquidating" labor.

Competition Versus Monopoly

Perhaps the next important question to be adjusted (if it can be adjusted) is competition versus monopoly. Very few believe in an uncontrolled business monopoly under our political institutions, but unfortunately during the last decade the public mind has settled into such a suspicious condition that many business methods, and even agreements and contracts, which are not only harmless but desirable from the standpoint of the public welfare are prohibited and business is certainly more or less hampered.

However sympathetic one may be with this hypersensitive public opinion, in view of many indisputably obnoxious business methods which brought it about, he must certainly stop short of approval of present laws when they protect the foreign buyer against the American seller.

The methods now fostered by these laws have been set out by Mr. John D. Ryan in his description of the tactics adopted in copper purchases by a foreign ring of buyers. The operation was simple—a group of large

*Chairman of the board of directors, Westinghouse Electric & Manufacturing Company.

copper buyers would get together in London or Hamburg, pooling their needs and advising small purchasers throughout England and Germany to place copper purchases in their hands for the purpose of getting lower prices. Then, as a next step, they would sell a few million pounds of copper short in the London market in order to establish a low quotation. With these preliminaries they would appear in the New York market for an astoundingly large order for copper and "shop it around." Naturally, the American producers, being forbidden by law to combine in submitting a price and equitably dividing the order, entered into fierce competition, with the result, as Mr. Ryan says, of a loss of about $60,000,000 annually to an American industry.

Foreign-Trade Exemption from Anti-Trust Acts

There is no valid argument against excepting foreign trade from the operations of the Sherman and Clayton anti-trust acts.

So far as the railroads are concerned, since they can do so little of their own free will or without previous approval by the Interstate Commerce Commission, they certainly cannot be blamed for failing to secure a sufficient amount of net earnings to pay return enough on capital to attract it to their needs; and, since there is no way of compelling investors by law to invest their money in railroads, it has been obvious that an increase in rates must be approved; but it has taken a very long time to get the relief, and in consequence it comes at a time when financial conditions could hardly be worse.

It seems quite certain that there is not, and probably will not be for some time, any European buying power of American railroad securities, and it is doubtful whether there is surplus capital enough in the United States to supply the railroads and at the same time do all the other work that is waiting if the work is to be done upon an essentially cash basis.

But we have ample labor desirous of employment, needing food and clothing; we have ample wheat for food, cotton for clothing, mills and factories anxious for orders, railways eager for traffic.

The present need, then, is the movement which will put labor at work producing, thus not only providing labor with means to purchase its food and clothing, but at the same time setting in motion the idle mills, factories and railroads.

This can be done only if, first, the wage demanded by the laborer is sufficiently less than the value of his product to allow the employer a fair margin of profit, and, second, if the employer either has or can obtain by credit the capital required to bridge the period until he receives returns for his products sold. By "capital" is meant not necessarily gold but accumulated stores and supplies useful to others, of which gold is merely the unit of measurement, being not in itself capital.

Therefore, with our accumulated wealth of wheat, cotton, manufactured materials and the like, our abundance of labor and facilities for manufacturing and transportation, we have sufficient instruments for bringing about general prosperity, provided only that confidence be restored and sufficient credit extended.

One other thing is essential, that while the laborer is worthy of his hire, he is not entitled to receive reward greater than value given. He must be content with fair and not relatively too high wages. On the other hand, he is entitled to, and must receive, a fair wage, sufficient for his support and something over.

Likewise, the railroad is entitled to receive fair compensation for the services rendered, sufficient for its support and enough over to pay a fair interest upon the wealth invested in it by its stockholders.

If the rates recently established by the Interstate Commerce Commission are high enough for this and to thus induce further capital investment, then capital and credit will be forthcoming; otherwise it is doubtful if the railroads, notwithstanding the rate increase, have yet solved their problems.

Effect of Tariff Reduction

The effect of the reduction in the tariff has been obscured by the war conditions, but the balance of trade was running against the United States when the war broke out. The tariff went into effect in October, 1913, with the result that the balance of trade (which in every month of 1911, 1912 and 1913 ran largely in our favor) began in April, 1914, to be against us. What the result would have been in the end is hard to say, but the immediate effect would probably have been very depressing even if there had been no war.

This year we were fortunate in having great crops. Those of the West and Northwest are finding a ready market and are creating a great buying power in that section. The South is not so fortunate in the cotton conditions, which have resulted in great depression there. However, the cotton will eventually be sold.

I have not the figures at hand, but the surplus of a crop which is 10 per cent above normal will build a good many miles of railroad, and every year we are nearer being able to furnish our own capital for our own needs, but until we accumulate surplus capital it will be a mistake to stop encouragement and protection of our home trade on the erroneous theory that we can seize, from either England or Germany as the case may be, enough export trade to make up for it.

Effect of the War on Regulation of Public Utilities

By Nathaniel T. Guernsey*

THE total wealth of the United States is roughly estimated at $150,000,000,000. Of this aggregate, more than $28,000,000,000 is represented by investments in what are commonly designated as public utilities, including the telephone, the telegraph, electric plants furnishing electric energy for light, heat and power and property employed in furnishing water-power, water, gas and transportation.

Experience has taught the public that competition, especially between local public utilities, is a public burden instead of a public benefit—that it means loss and poor service, with eventual consolidation as the remedy. The public has turned from competition to regulation, and to-day practically all of the utilities in the United States are subject to regulation by one or more tribunals, federal, state or municipal.

*General counsel American Telephone & Telegraph Company.

Regulation Governed by Public Interest

Broadly, what determines the scope of this regulation is the public interest, which is that the service furnished by these utilities be good and efficient service, available to the entire community, that there be no discrimination between members of the community, and that the price charged for the service be reasonable. Discrimination has never been a factor of great consequence from the public point of view, except in connection with the operation of the railroads, and as to them it has been largely eliminated. It may be noted in

passing that in what was its most offensive form, namely, rebating, it was the outgrowth of competition for business. Questions as to service still arise, and will continue to arise, but they are not and will not be of controlling importance. The modern public utility is well managed and has thoroughly learned the lesson that it is to its advantage to give to the public the very best service which the rates paid by the public will permit.

The serious, vital question which is involved in this experiment, because regulation has not yet passed beyond the experimental stage, is presented in connection with the determination of the return which must be earned upon this enormous investment. The indirect effect of the concrete experiences growing out of the present European war promises, in connection with the solution of this question, the most lasting and important influence of the war upon the utilities of the United States.

The direct effect of the war upon the utilities has been obvious, but will be merely temporary. Because the utilities are essential parts of all business transacted in this country, war between the principal nations of Europe, with which we have most intimate business relations, could not fail to react to some extent upon the business of this country and of its utilities; but this war cannot permanently impair business conditions in the United States. The effects of the sudden readjustments which the war made necessary are already beginning to disappear. Ultimately, the result of the war should be to increase and not to decrease the business and commerce of the United States.

Fundamental Truths Demonstrated by War

But the war has afforded a striking, concrete application of some of the fundamental propositions underlying the adjustment of rates of public utilities which should demonstrate the soundness of the views of the commissions which have commenced to recognize these principles, and which should be of immense permanent educational effect in connection with the matter of rate adjustment.

There have been grave and fundamental misconceptions as to what in fact determines the amount of the returns which public utilities must earn. These misconceptions have been due largely to a failure to correctly apprehend two fundamental facts—first, that a public utility requires continual additions to its capital, and, second, that this capital must be acquired in a competitive market.

Theorists, in discussing these matters, have looked at the investment in a public utility as a fixed thing, and have discussed the amount of the return upon the assumption that this investment is already made, is used for the benefit of the public, and cannot be withdrawn. This is fundamentally wrong, in that it ignores the big, persistent, practical question in financing public utilities, which is, how shall the new money be obtained to provide for the constant additions to the plant which are necessary if it is to serve the public properly and keep pace with the development of the community? This is a live, vital question, which arises year after year, and every year.

It is useless to theorize as to what money invested in utilities ought to earn. It is impossible to establish any fixed rates, as 7, or 8, or 9, or 10 per cent. The question is a practical and concrete one. It is, what rate of return is essential in order to enable the utility to secure the new money that is absolutely necessary if the utility is to perform its functions efficiently? This rate is not, and cannot be, fixed, because conditions affecting the money market are not permanent but are constantly varying. This proposition underlies the conclusion of the Interstate Commerce Commission in the "five per cent case," filed Dec. 16, 1914. The commission says:

"The conflict in Europe will doubtless create an unusual demand upon the world's loan fund of free capital, and may be expected to check the flow of foreign investment funds to American railroads. It appears that our railroads represent the bulk of European investment in this country. The rate of interest—the hire of capital—has risen during the last decade, and may rise still further. It is computed that in the years 1915, 1916 and 1917 the carriers in official classification territory must arrange for the payment or refunding of securities aggregating over $500,000,000 * * * But we do not doubt that the financial problems of the carriers have been made much more acute by reason of the war, and if we are to set rates that will afford reasonable remuneration to these carriers, we must give consideration to the increased hire of capital as well as to other increased costs."

The new money for public utilities must come from the general fund seeking investment, made up of the combined savings of the public. The investors who own this money are not controlled by philanthropic purposes in making their investments. The money will go where, all things being considered, it will receive the largest profit. Public utilities will not obtain the portion of this fund which they require unless they are allowed a return which will successfully bid for this money in this competitive market. The most important effect of the war upon the public utilities of the United States is that it has brought these things out into sharp relief, through actual experience. This experience has demonstrated the unsoundness of the contention that there is some standard return which is adequate for money invested in public utilities. The declarations of war created conditions so radically affecting the money market that securities were offered in such quantities that it was necessary to close the exchanges of the world to avert a panic. This demonstrates conclusively that a profit which will make an investment attractive under some circumstances is utterly inadequate where the conditions have radically changed, and that this profit must and will vary with the variations of the conditions affecting the money market.

Again, this experience has thoroughly exploded the fallacy underlying the contention frequently made that because the money invested in public utilities is devoted to a public use it is not entitled to as much profit or return as money devoted to private uses. The money which supplies the fund for investment in public utilities comes from the aggregate of the small savings of the entire community. The very great proportion of these investments is in small amounts. Most of these investors could not afford to furnish this money for the public for less than it is worth in the market, and none of them are disposed to do this.

The Investor and the Utilities

In the final analysis, the investor determines the price which the utilities must pay for his money. It is he who finally determines whether the prospective profit is attractive enough to induce him to part with his money.

The regulation of public utilities will not be established upon a sound basis until these propositions are understood and recognized. Their soundness will be conceded by the public as soon as they are brought to the attention of the public in such a way that it clearly understands them. The public utilities cannot furnish service at less than it costs. Regulation may bankrupt some utilities, but it cannot, in the long run, obtain service for less than it costs, and as a part of that cost there must be reckoned the cost of the money.

The prompt recognition of these propositions is to the interest of the public as much as it is to the interest of the utilities. The enormous investment in these utilities is the investment of the public; it represents the savings of the public; its protection is the protection of the public. And there is another equally important public interest. The public requires efficient service available to all. Such service cannot be rendered by a public utility which is not receiving adequate compensation. It would be a short-sighted public policy, that could only result in failure, which attempted to secure this service for less.

Future Prospects of the Electrical Export Business

By M. A. Oudin*

AN analysis of our electrical exports, as far as the rather unscientific method of classification permits of such examination, discloses the fact that the United States holds a most important position in respect to the exports of apparatus of large capacity, and especially of electrotechnical machinery which demands engineering and designing talent of a high order in its production. In Japan, India, South America, Mexico and Canada—in fact, all countries but those of Europe where water-power development has been a striking industrial feature—American hydroelectric machinery will be found to be generally preferred to similar apparatus of other countries.

America Outdistanced by England and Germany

On the other hand, the record shows that the United States is far outdistanced by both England and Germany in the export of small apparatus and electrical devices. The proportion of exports of such electrical appliances and energy-consuming apparatus to machinery of large capacity is in an inverse ratio to the employment of these two general classes of electrical products in the United States.

The inference to be drawn from this aspect of the electrical trade, foreign and domestic, is that the former is largely carried on by manufacturers who by means of their resources have advanced the art and design of electrical manufactures and established effective selling organizations abroad, and in consequence have been enabled in the world's markets to overcome partially the competition of other great manufacturing nations. Another and more important inference is that the future development of the export trade in electrical machinery and supplies, on any great and comprehensive scale, depends upon the extent to which the very numerous small manufacturers will recognize the necessity for a broader export market for their goods and will apply themselves to the task of winning it.

So long as the war lasts, and probably for some time after its close, American export trade in all lines of manufacture, save those for which the war has produced a direct demand on the part of the belligerents. will more or less languish, following the trend of international trade. The reasons for this are well known, being principally the diminished purchasing power of neutral countries and the paralysis of business activities as a result of the war. The future prospects of the electrical business after the war is over particularly concern us, and they will be briefly considered.

Conditions When the War Is Over

Regardless of the duration of the war and of the extent of its devastation and of the financial exhaustion produced by it, so long as the physical properties and industrial plants of our principal competitors are not destroyed their manufacturing predominance will not be seriously affected and their competition, potentially and otherwise, will remain most formidable. Both sides will emerge from the wreck and ruin of the war with a keener desire for foreign trade and a corresponding skill and alertness and a greater determination than ever to win it. But both sides may not then be in a position to compete on the same footing as before, either with each other or with the United States, because of the conditions which the victors may possibly impose upon the vanquished. The future foreign trade of the United States may be greatly affected by the outcome of the war.

Should the dual alliance finally win, a number of important markets which have been shared by England with the whole world would be hard to hold. It is conceivable that our most formidable Continental trade rival might become industrially so powerful as to make competitive and commercial opposition very difficult. The expansion of our business abroad would then be attempted under a greater handicap than any which now exists.

The greater opportunity of the United States lies in an international condition which will maintain the world's markets as free and as open as they are to-day. It seems to be evident that on account of racial feelings, unfortunately aroused by the war, the countries at war with Germany, their colonies and some neutral countries will either cease to purchase German goods or will greatly lessen their dealings with that country. Germany will then be partially eliminated, for a more or less indefinite time, from participation in the trade of a number of countries which have been large purchasers of her. The contest for this trade will be largely between England and the United States. To-day England is making a most effective campaign to capture the trade Germany has hitherto enjoyed. In addition to the war now waged by means of her armaments on land and sea, she is making a most vigorous war on German trade. To this end the English government is taking a very active part.

Energy and Resourcefulness Needed

The present is a time when the energy and resourcefulness of American manufacturers must be put forth in an effort to capture foreign markets, with at least the same intensity that has been shown in the development of our industries at home. We should first of all address ourselves to reducing the cost of production. Generally speaking, our selling prices in the world's markets are too high. We should adopt a new attitude toward foreign credits and financing foreign enterprises, remembering that a very large percentage of the export manufactures of England and Germany is the result of their having invested their savings in the enterprises of other countries. We should adopt as far as applicable to our industrial organization the methods of selling abroad employed by our competitors. We should invoke government assistance as far as is consistent with our domestic problems. Especially would it pay us to give particular attention to the activities now being displayed by England in the commercial war upon her greatest competitor.

Another very important point for consideration is the

*Manager foreign department, General Electric Company, and member National Foreign Trade Council.

obstacles to the extension of our foreign trade arising from the existence of certain federal laws upon our statute books. In the first place our antiquated marine laws impose burdens and conditions on steamships flying the American flag so that they cannot be operated economically or in competition with ships of foreign registry. The laws distinctly discourage any increase in our merchant marine. Again, the anti-trust laws, while passed for the protection of the American consumer, so read as to tie the hands of American exporters and prevent their competing with the foreigner on the same terms.

There should, of course, be no restriction upon the proper and reasonable enterprise of American manufacturers, whose aim is to increase the foreign trade of the United States by united effort. Yet export associations and combinations to this end are prohibited by the present laws. The removal of this handicap will enable small manufacturers to seek in a competitive manner foreign markets from which they are now expressly prohibited.

Factors Which Govern Electrical Export Trade

The factors governing the export trade in electrical products are the same as those which influence the trade in other lines of manufactures. Consequently the general conclusions to be drawn from this brief survey of the export situation are applicable to the electrical industry. We may conclude that the future prospects for the American manufacturer of electrical machinery and supplies are bright. An increase of any consequence in electrical exports cannot be expected at the present time. We can confidently look forward to realizing in the future broader export markets for electrical machinery and supplies, provided always, however, that the present is devoted diligently and intelligently to investigation and adequate preparation, with this object steadily in view.

Results of the War for Public Service Commissions to Consider

By Henry Floy*

TO the casual reader of the above title there would seem to be no connection between the European war and the regulation of our public utilities in America. But to one who weighs the matter it will be seen that not only must the war affect the practices of public regulating bodies but that it has already begun to have such an influence.

Within a few months the European war has shown what would ordinarily have taken years to demonstrate clearly, namely, that the regulations and decisions of our public utility commissions are but ephemeral and must be revised from time to time. It has shown that questions answered by public regulating bodies with the best light available and with more or less assurance that permanent solutions have been reached cannot be considered as finally settled, but must rather be held to have been answered for only the time being, and will always require amending and re-settling, depending upon shifting conditions and fluctuating financial markets.

The professional philanthropist has been accustomed to argue that once regulation became effective the rates of any corporation could be so fixed as to permit earnings that should provide an exact and minimum so-called fair return on the property used, and that under such circumstances there would be no need for further consideration of the subject, except possibly to order reductions in rates from time to time as inventions, improvements or increased business allowed increasingly larger earnings to be realized.

Higher Interest Rates

Interest rates are likely to continue higher than in the recent past, owing not alone to the conditions which have prevailed since the war was started but also to the inevitable after-effect of greater demands for capital for reconstruction and the re-creation of property lost and wasted. In common with other corporations, utilities have felt the results of the general public demand for reduction in the profits of corporate properties; and many utilities operating under public regulation have found that the cost of money is too high now to permit them to make additional capital investments with assurance that public regulating bodies would permit the higher rewards demanded at present by capital. Consequently new construction has been curtailed to the minimum, and expenditures for improvements that were absolutely necessary have been financed through short-time notes or similar obligations.

Almost uniformly the precedents and decisions of state commissions and courts have held thus far that, while it was necessary to provide for operating expenses, an allowance for depreciation and a return on the value of the property, nothing at all, or at least no special allowance, was required to cover exigencies or contingencies. The result is that utilities generally have been forced to pay out all of their earnings to maintain their standing and conserve the market value of their securities. Now that the European war has created unusual demands for money and that capital is insisting upon increased rewards, prevailing rates for services in all the markets of the world must be increased if public utility corporations are to be enabled to secure the additional capital required for their constantly growing properties.

One Reason for Public Utility Troubles

Aside from the war, the primary reason for the pinched position in which some of the public utilities find themselves is the failure of the individuals on some of the state public service commissions to adopt a statesmanlike attitude toward the problems brought before them. When it is possible for men who have never shown any particularly great business sagacity or engineering ability, mediocre lawyers and individuals whose chief recommendation has been activity in behalf of municipal ownership or increase in the number of federal, state or municipal employees, to be selected as public service commissioners, the policy of regulation is in serious danger.

Executives and managers in charge of public utility properties, having devoted their time and energies from youth up to the construction and operation of such properties, usually have won their present positions, paying as much as $25,000, $50,000 or even higher salaries per year, as a result of competition and proved qualifications. In some states public service commissioners receiving $2,500 to $5,000 a year are passing on business matters involving $100,000,000, although these men have never evinced ability to originate or partici-

*Consulting engineer, New York.

pate or co-operate in any large business enterprise. Such men cannot be expected to understand and appreciate—and, as a matter of fact and common knowledge, they do not—the necessity for scope, flexibility and allowance for some freedom of action in large affairs. Sometimes men are appointed to membership on commissions who have the ability to grow, and they enlarge their viewpoint so that after a few years of service they develop the proper judicial attitude and render decisions that are constructive, liberal and fair to both the public and the companies. The result of the European war upon these public servants must be to make them appreciate that rates for capital will vary with money conditions; that while commissions may be able to force reduction of rates, they cannot compel investors to put their free capital into unattractive or unremunerative enterprises. Rates for capital must be made attractive and comparable with returns allowed in other and equally risky enterprises, or no money will be forthcoming to provide the necessary additional extensions of property required by utilities.

Conclusions

The European war has therefore hastened recognition and appreciation of the facts that:

First—Rates of return allowed public utilities are controlled primarily by current demands and rates for money, without regard to regulating or law-making bodies.

Second—Decisions of commissions made at a specified time under a particular set of conditions may have to be revised promptly when these conditions are changed.

Third—The limitation of rates of return to 6, 7 or 8 per cent, as has been held fair by public authorities under past conditions, must be increased under existing and probable future conditions if utilities are to secure the additional capital they require.

Large Questions of Public Policy Before the Electrical Industry

By W. W. Freeman*

ONE of the problems confronting the industry at the present time is that of educating the public to the importance of stabilizing the earnings of public service companies as a matter of advantage to the people.

For several years the public policy committee of the National Electric Light Association has devoted much time and effort in urging upon the industry the importance of recognizing and practising the most modern ideas as to the obligations of public service companies to the communities which they undertake to serve. The "humanizing" of the industry has been the burden of several reports and recommendations which have been cordially received and generally followed. While this educational work among ourselves has been timely and useful, it may not be amiss to consider whether there is not special justification and necessity just now to point out the duty which the public owes to itself to enable the public service companies to serve the public satisfactorily and adequately. There is possible danger that the liberality of companies toward their employees and their customers may be misinterpreted as indicating unusual prosperity, and that the very manifestation of efficiency and liberality may invite unjust criticism and attack.

Fundamental Facts

There are certain fundamental facts affecting the relation of the utilities companies and the public that should be constantly kept before the public. It should be better understood than it appears to be generally that all public service companies that are properly performing their functions are doing a real and necessary service.

If it were not for such companies, the municipalities would have to provide the capital and perform the service. In many, if not most, cases this would be impossible. Where private capital provides the service the municipality is not only relieved of all financial burden and risk but additional revenue is provided through taxation of the company. This is a twofold advantage to the public, provided, of course, that the service furnished is as good and as cheap as the city itself would be able to supply. To those who are in position to know the facts no proof on this point is necessary.

In enlisting the service of a public utility company for its people the municipality should be principally interested in seeing that the service provided is adequate and first-class in every particular.

The rates charged should be reasonable, but they should be high enough to earn and secure a proper standard of service. As between low rates and poor service, on the one hand, and reasonable rates and good service, on the other hand, the public will generally choose the latter, if it really understands the situation. The trouble in some cases is that the ignorant or prejudiced are misled into thinking that the company would like to charge the highest rates obtainable for the poorest possible service.

The time has come for the intelligent people in every community to realize and preach that the public owe it to their servants, the utility companies, to recognize their services at their face value, and not expect to receive loyalty and efficiency in the inverse ratio of the distrust and abuse meted out to them.

What Profit Really Is

When the proper relationship between the quality and the cost of the service has been established the other factors are comparatively easy of adjustment. Even the question of profit offers no real difficulty when it is appreciated that the company merely seeks the measure of profit necessary to provide proper and adequate service. What is called profit is in reality an unavoidable element of expense. It is the wage the company must pay for the capital employed in the business, just as it must pay wages to its employees. If the wages paid are inadequate, the employees will seek work elsewhere, and similarly if the wages to capital, or the dividends, are below the prevailing standards, the company will be unable either to retain its full present capital, because of shrinkage in market value, or to obtain the additional capital which a public service company must continually have to further the development of its business.

If in a private business the enterprise is unable to serve its customers, that business alone suffers as the customers merely go elsewhere for their needs, but in

*Past-president National Electric Light Association and Association of Edison Illuminating Companies.

the case of a public service company with an entire community depending upon it the people are as much the losers by reason of poor and insufficient service as are the stockholders of the company.

It is strange how many sincere persons think that the profits earned by utility companies are very large, whereas the same people would not be satisfied in their own business with several times the rate of return which is received by the investors in public utility securities.

Possibly the best proof of the sincerity and good intent of utilities companies generally is the fact that the rates have not been materially affected by reason of the drastic regulation of rates and methods which has been applied throughout the country in recent years. While rates have been reduced in some places, they have been ordered raised in others, and it is safe to say that such forced reductions as have been secured have been no more radical than the purely voluntary reductions in former years.

In short, regulation by the public has served more to emphasize than to change the policies of the industry. This is a fact that we are justified in making known as entitling our companies to receive the good will of the public.

"Service First" Should Be the Actuating Motive

The slogan "Safety first" has recently been used very effectively, in our industry and others, in arousing interest in the important object of accident prevention. Possibly the words "Service first" may be used to express the underlying thought that should actuate both the public and the utility companies in their mutual relations. If service in its fullest sense be considered the first requisite, there can be no excuse for refusal or unwillingness to grant to any companies an earning capacity which should be sufficient at all times, and under all recurring conditions of ease or stress, to render a service uniformly good and correspondingly valuable to the public.

The Art of Rate-Making

By Alex Dow*

WHEN an electric-light company was only a lighting company, selling light at night in competition with gas and trying hard to sell enough energy to pay for the coal used on the day run, rate-making by guess was fairly safe and was likely to be equitable. People who bought electricity for lighting were paying for a novelty, an advertisement or a luxury. People who bought electricity for motor service were paying for convenience and knew it. And the highest price obtainable was in most of the early ventures too low to be profitable.

Now that electricity supply has established itself as a public service in the broadest sense, when the smallest apartment and the largest industry are alike dependent upon the central station, when at one end of the rate schedule the service must compete with that given by highly efficient steam plants and at the other end must be within the reach of the workman's family, the making of rates is an art guided by rules which are shaping themselves into a science.

Rate-Making an Art

Rate-making will continue to be an art, because rates are made for the future. Science can show exactly whether last year's rates were fair or unfair, adequate or inadequate *last year*. It needs art, and skill in the art, to estimate the undeterminable factors that will control costs and sales next year and in years thereafter.

What is given below is based upon twenty-five years of personal experience. For the first seven years of that period my rate-making was empirical—not to say haphazard. For the last eighteen years it has been increasingly methodical, following rules which I have held to be in accordance with the underlying equities. These rules are given here, not as a code of the law or the equities, neither as a challenge to discussion, but for what they may be worth to others studying the same problems. In my case they have served their purpose, apparently to the complete satisfaction of everyone concerned.

A rate schedule must, when applied to the total service to be dealt with—that is to say, the total business of the company for any given period—provide for the payment of all the costs of performing all the service and in addition thereto must provide a reasonable return, for that period, upon the total investment devoted to the service.

Reasonable Return Upon Investment

It is convenient for our present purpose to consider the reasonable return upon investment as something separate from the cost of performing the service. But the reasonable return is truly part of cost. It is the cost of the necessary capital. A reasonable return is that return which will bring freely the necessary capital into the service—neither less, else the capital will not come, nor more, else an excess of capital will be invited.

The cost of service includes the maintenance of the operating efficiency of the plant and also the maintenance unimpaired of the invested capital. These maintenance costs must be collected as they accrue, not as they fall in. Else future service will have to pay part of the cost of past service, which is unjust. Therefore a depreciation reserve, or other acceptable method of insurance against coming impairment of efficiency or impairment of capital, must be taken into the reckoning in rate-making.

Each Class Shall Pay Its Cost

If a rate schedule provides for classification of service—as practically every schedule does—the respective class rates must be such that each class shall pay its own costs. Otherwise one class must pay the cost of service to another, which would be unjust. This may be put concisely thus: No class of service may be performed at a loss. It would be well that no single customer should be served at a loss, but that would require a meticulous exactness of rate-making and of accounting impossible in public service. The law disregards trifles. Public service may well do likewise when assured of their triviality.

The converse to the requirement that no class of service may be performed at a loss is: The rate schedule must not require from any class an excessive return upon investment. Between these limits—that no service may be done at a loss and that none must be called upon to pay an excessive return—the adjustment of the rate is a matter for business judgment.

Value of the Service

Here the much-discussed factor of value of the service enters into rate-making, and here only does it enter.

*President Edison Illuminating Company of Detroit.

Simultaneously and equally there is required consideration of the value of prospective business to the established business in giving a broader basis for the burden of costs. It is permissible to take business at a rate which merely repays to the utility the costs (including capital costs) incurred by the addition of this business. But it is not desirable to do so. Low increment cost is an index of desirability, but to make the business desirable it must not only pay its increment of cost but must contribute to the good of the utility as a whole. That term, the utility as a whole, means that it takes customers as well as investors and organization and plant and management to establish a complete utility.

The interest of customers in new business is that by increasing the use of an existing investment, or by sharing in overhead expense, it will reduce the costs to be borne by existing business and thereby tend to reduce rates. The interest of investors in new business is that it tends to greater stability or greater rate of return.

The value of service to the customer is the upper limit of any possible rate. The increment of cost is the permitted but undesirable lower limit. The value of accepted business to the utility as a whole—the new customer and the old customers as well as the company—is the measure of skill in rate-making.

The Determination of Class Costs

Obviously the determination of class costs calls for an analysis of expense over and above that contained in any state or association classification of accounts. The principles of such an analysis have been published many times. The differences in practice are many and the possible refinements are legion. But a comparatively simple analysis will serve for the making of an equitable rate schedule and will prevent any business being taken at a loss or any being asked to pay an unreasonable profit. The first essential is a separation of all costs (including capital costs) into the three basic cost classes—costs varying with the number of customers served, costs varying with demand, and costs varying with the use of energy; that is to say, with the kilowatt-hours sold.

The second step is to assign these separated costs properly to each class of service to which is offered a different rate, according to the number of customers, the class demand and the energy used by each class. Every company knows how many customers there are in a class and how many kilowatt-hours are billed, but few companies have measured or estimated the demand chargeable to each class. A close estimate can usually be made and will serve for a first analysis.

Distribution of Depreciation Reserve

Be it noted that depreciation reserve (or whatever substitute therefor is adopted) must be distributed to all three of the cost classes. Some items of depreciation, notably on meters and service connections, vary with the number of customers and must be assigned accordingly. The depreciation of certain other parts is a function of their use—that is to say, it varies with the kilowatt-hours sold and must be reckoned accordingly; but this part is usually minor. The major part of the depreciation charge is naturally assignable to the demand column.

The plant capacity, and thus the capital cost, varies with demand; but it must not be overlooked (as already noted) that meters, service connections, and so on, vary with the number of customers and little or not at all with demand, and their capital costs must be assigned accordingly.

What the Completed Analysis Will Show

Having thus separated and redistributed the costs and set costs opposite earnings for each class of service, the completed analysis will show many things. It will show whether any class is failing to pull its share of the load, or whether it is carrying the burden of other classes. It will show where a lower rate is earned and where any claim for a lower rate ought to be resisted. It will show what any proposed service would have cost last year, and so guide the management in judging its prospective value to the utility. It goes without saying that it will prove the Hopkinson and Wright dicta (which no longer need proof) as to the comparative costs of long-hour and short-hour business. But it also will prove other things less well known, or even denied—for instance, that the energy costs are almost negligible in the total cost of serving the average residential customer while the service or customer costs may be one-half of the total; that the customer costs are almost negligible in average commercial service, and entirely so in industrial power service; that in a metropolitan city served by efficient steam-electric plants, where taxes are high and real estate brings big prices, and all mains and services are underground, the cost of capital may be the greater part of the cost and that it may equally be so in a village served by a transmission system from a water-power.

Discrimination Disguised as Classification

For the study of an existing rate schedule, analysis according to existing rate classes is sufficient. For the making of a new rate schedule or for the study of some particular service additional classification may be needed. Classification may be insufficient or may be excessive. It is insufficient if it throws into the same class divers groups of customers whose group costs are essentially different. It is excessive if it selects one or a few customers to form a favored class in recognition solely of the superior trading ability of these customers. Excessive classification in this manner is the fault for which the railroads of the United States have been most bitterly assailed and most severely punished. As to the justice or the injustice of the accusation and punishment, I have nothing to say here. What I have to say is that discrimination, disguised as classification, is unsafe as well as unjust.

Feature of Adequate Classification

An adequate classification, then, will separate services having essentially different cost characteristics—such as lighting service requiring close regulation and maximum reliability, industrial power where the cost of exact regulation is unnecessary and reliability is relative, wholesale delivery of service at central points, retail delivery scattered here and there over a county, residential service with its deferred peak and its characteristic time difference between the individual maximum demand and the class maximum demand, and commercial lighting where the class and individual maxima are coincident. Individual differences in load-factor do not require recognition by classification and are better taken care of by a Hopkinson or Wright form of rate. The rule is that the classification must be based upon well-defined class characteristics, the definition to be clear enough to leave no doubt as to the class in which any customer belongs.

To conclude, these are the principal rules which I have followed in making rates. Of minor rules and of minor preferences there is no space here to write and there is in them the making of many books—from which I pray to be excused.

Recent Developments in Prime Movers

By W. F. Durand*

THE insistent and unchanging demands in the field of central-station engineering are economy and reliability, and the activities of the central-station engineer are continually to be judged with reference to these two fundamental demands.

The past year has been one of unremitting effort toward advancement along these lines of progress, though without results of a spectacular or epoch-making type. It is perhaps not too much to say that so long as thermal-power engineering has to deal with the present known methods of heat liberation and transformation no further great advances will be possible. So well developed have been the possibilities of our present accepted methods that further improvement must of necessity deal with the outlying margin of loss which we have not yet learned to control. In fact, in so far as economy is concerned, the work of the power engineer is now primarily concerned with the diminution and prevention of a series of losses more or less secondary in character with reference to the main problem of power development.

Boilers and Fuels

Thus in the boiler room the available fuels remain, as hitherto, coal and oil, with occasional use of gas (natural or producer) where special conditions permit. The principles of ordinary combustion are well understood and the further work of the power-plant engineer is concerned chiefly with the attempt to realize, as closely as practicable, physically perfect conditions. Some progress has been realized through the year in a wider understanding of these principles and in a better appreciation of the part which indicating and measuring instruments may play in determining the actual conditions of operation. Thus flue-gas analyses with flue and stack temperature recorders are more and more depended on to furnish the indications on which an intelligent study of loss control must depend. In certain large stations which have recently come under the reviewer's notice the leading firemen have been provided with flue-gas analysis outfits and are instructed in their use, quite empirically and with no real understanding of the chemical principles involved. They are taught simply to make observations and to control the fuel and air supply in accordance with the results. In other cases, in increasing numbers, automatic flue-gas analyzers are provided and the graphic results indicate similarly the proper control of fuel and air supply.

Saving in the Fireroom

This all indicates a widening appreciation of the possibilities of saving in the fireroom and in connection with the fundamental problem of heat liberation. In a broad way boiler economies of 80 per cent or a little better are now realized. The remaining 20 per cent escapes primarily by way of the stack. There are here two large and important problems which confront the power engineer. These are the raising of the best boiler efficiency and the raising of the average with reference to the best. With reference to the first of these, certain hopeful possibilities were held out some few years ago by the work of Professor Bone, of Manchester, England, through the method of surface combustion. This method seems not yet to have reached the stage of practical application on a large scale, though we may hope for such development as a result of continued study. As a matter of national conservation it is undoubtedly far more important to raise the average of boiler efficiency well up toward 80 per cent than it is to demonstrate in individual and detached cases efficiencies of 85 per cent or thereabouts. Such an advance in the average efficiency of boilers throughout the country would mean enormous savings in fuel and a corresponding economy in the use of a limited natural resource.

As an incident in the struggle for higher boiler efficiencies with oil fuel, reference may be made to the continued search toward improvement in methods of atomization. The whole program of atomization and introduction into the furnace is fundamentally one of preparation of fuel, and as such it stands as a charge against the steam produced. With steam or air as an atomizing agent, the toll in terms of steam is about 3 per cent under good average conditions. With mechanical atomization by means of jet orifices of various forms, the cost in terms of steam may be reduced to about 1 per cent. It remains as an outstanding fact, however, that the thermal efficiency of the boiler with steam or air atomization seems a shade better than with mechanical atomization so that the final result is somewhat inconclusive. The general subject of mechanical atomization for oil fuel is, however, attracting keen attention on the part of engineers and inventors, and we may confidently look for such improvements as shall raise the thermal efficiency of the boiler to an equality with that realized in steam or air atomization, thus leaving a margin of 1 or 2 per cent saving in over-all fuel expense.

Some attention has also been given to automatic time-indicating devices for controlling the firing program with large batteries of boilers. Time-controlled firing has long been a feature of marine service, and with a reasonably steady load there should be an excellent opportunity to apply this method to central-station work.

Smoke Prevention

The subject of smoke prevention or smoke combustion continues to attract serious attention in some of the large manufacturing centers, and a number of special furnaces have been brought forward for use in the campaign for smokeless combustion. The principle of these furnaces involves generally some method of mixing the smoke in the furnace, after formation, with sufficient air for combustion and of then passing the mixture through some form of combustion chamber where the temperature is above the point of ignition. Thus all the conditions for combustion are realized, the carbon is consumed, and the gases pass on smoke-free.

Some interest has been noted in the oft-tried problem of the economical combustion of pulverized coal. Coal in this form burns readily with an intense heat, and the method, if reduced to a thoroughly practical basis, would open up enormous supplies of low-grade or refuse fuels. The control of the temperature presents difficulties, and this feature together with troubles of detail with the pulverizing and feeding apparatus renders the present over-all economy somewhat problematical. The time will doubtless come, however, when this general method or some other equivalent one will be required to make available the enormous deposits of low-grade fuels which so far we have been able to discard.

Some progress should be noted in boiler design for high-pressure steam. One new design has been reported on during the year, representing the results of several years of investigation and intended to provide steam at working pressures up to 600 lb. and with 300 deg. of superheat. Thus far these boilers have only

*Professor of mechanical engineering, Stanford University, California.

been built in small sizes, but hopeful indications are reported looking toward a combination of such a type of boiler with engines of the una-flow type, promising still higher economies for the steam-driven prime mover of the reciprocating form.

Steam Turbines

The steam turbine remains, as during the past few years, supreme in the field of large central-station work. There has been some progress in structural details and some advance in the size of units. The 30,000-kw unit may be said to have arrived and the 50,000-kw unit has at least entered into the field of the designer's computations and plans.

A report to the American Institute of Electrical Engineers in June last, reported in abstract in the ELECTRICAL WORLD of July 4, gives an excellent résumé of the present status with special reference to large central-station practice. In the report the thermal efficiency is recommended as the only just criterion, a point which has often been insisted upon in these columns. Reference is further made to the economic performance under standard conditions of 175 lb. pressure, 100 deg. superheat, and 28.5 in. vacuum expressed in terms of a water rate. From these results it appears that a rate of 14 lb. per kw-hr. is passed at an output rating of about 5000 kw, while a rate of 13 lb. is reached only at an output of about 30,000 kw. This indicates the wide range of capacity over which the rate changes but slightly, and by inference, also, the comparatively small further improvement in economy to be anticipated from advancing sizes.

A recent development of interest with some of the largest-sized turbine units shows a combination of two or more elements with motors at different speeds, taking steam in series; as, for example, a high-pressure single-flow element at 1500 r.p.m. combined with a double-flow low-pressure element at 750 r.p.m. In this manner full advantage is taken of the best rotative speed for each element, and the gain is considered more than to counterbalance any small loss due to the subdivision of the generator.

In medium sizes and small sizes no great advance has been made in the turbine so far as efficiency is concerned, and in small sizes it remains distinctly inferior to the reciprocating engine of the more economical forms. In this field of work the use of the turbine will be justified not by any advantage in efficiency but rather by considerations of first cost or of availability for high rotative speeds, or by some combination of the two.

In this connection reference should be made to a well-defined downward tendency in the cost of turbine and turbo-generator units in relation to rated output. As a result of this tendency the turbine is the better holding its own in competition with high-economy prime movers of the internal-combustion type, of which the first cost is necessarily high.

The Reciprocating Steam Engine

The chief interest during the year in prime movers of the reciprocating steam-engine type has been in connection with special forms such as the una-flow or locomobile types. The conventional and standard form of reciprocating engine has been improved and standardized to such a degree that it seems hardly possible to anticipate any considerable further improvement in this type of thermal prime mover.

The "una-flow" engine is attracting serious attention in the United States, and in Europe it is displacing compound engines for many types of service. Several leading engine builders in the United States are now building engines of this type, with a steam consumption of from 11 lb. or 12 lb. per hp-hr. for high pressure, superheat and condensing operation upward to 20 lb. or thereabout for more moderate pressures, saturated steam and non-condensing operation. The significant fact which seems to have been demonstrated by this engine is that the characteristic economy of the compound or multi-stage engine can be closely approached or substantially realized by a single cylinder acting on the "una-flow" principle. This development in the reciprocating engine has now assumed important proportions, and no power-plant engineer who is concerned with a problem involving small units with the need for high economy can afford to overlook the possibilities offered by this type of prime mover.

Mixed-Flow Turbines

Combinations of reciprocating engines with turbines continue to occupy the attention of engineers and seem admirably adapted to the requirements of certain special cases. This combination has found its ordinary application in the case of extensions to existing stations already equipped with reliable prime movers of the reciprocating type. Many such have been noted from time to time, one of the more recent as well as one of the largest being the Commerce Street station in Milwaukee, with a total equipment rating of 61,900 kw. In other cases of new design where power for industrial purposes is required and where the mechanical characteristics of the reciprocating engine may be of value the mixed system offers peculiar advantages and has met with a measure of favor.

Internal-Combustion Engines

The tendencies which recent years have shown in the development of this form of prime mover have continued with increasing emphasis during the past year. So far as central-station practice is concerned, the use of internal-combustion engines is limited to those of small size and where small units will meet the conditions. In a few cases large power is developed with a large number of units of moderate size, but only in the case of a supply of fuel practically as a waste product could such installation be justified.

There are two well-marked types of internal-combustion engine competing with other forms of prime mover for small or moderate unit service—the gas engine using producer gas of some form and the Diesel engine using liquid fuel. Activity with each of these types has been noted.

An interesting method of increasing the permissible output of gas engines which has been brought forward during the year consists in special provision for scavenging out the burned gases and then introducing the fresh charge under pressure. This secures the introduction of an increased amount of fuel in relation to cylinder volume and a corresponding increase in output. Interesting combinations have been worked out whereby the work of compression of the charge is furnished by steam generated by heat from the exhaust of the engine, thus securing a direct saving and an increase in over-all economy. A limit to the application of this method will, of course, be found in the rising pressures at the end of compression and in the limit at which pre-ignition is liable to occur. Within this limit the method would seem to offer hopeful possibilities.

With the Diesel engine there continues to be marked activity and some extension in the field of application. In the minds of many engineers there remain residual doubts regarding reliability over long-time operation and with heavy gravity oil of asphaltum base. First costs also continue high, and thus the question resolves itself into the weighing of low fuel cost against high fixed charges, with some uncertainty as to costs of upkeep and some doubt regarding general reliability. The general conclusion to be drawn from the trend of recent practice shows plainly, however, that an increasing

number of engineers are becoming satisfied as to the over-all advantage offered by this type of prime mover within certain limits as to sizes and conditions of operation. For small stations of capacity up to 1000 kw or perhaps 2000 kw the possibilities of the Diesel engine are such as to merit the most careful study and comparison with other methods of design. In the matter of size record may be made of a 600-hp four-cylinder Diesel engine of American make recently completed for pumping service in the Hawaiian Islands. This is the largest engine of this type yet constructed in the United States. This engine was furthermore built and has been accepted on a guarantee of continuous operation for 710 hours out of 720 hours per month on California asphaltum-base fuel oil of gravity 14 deg. to 18 deg. Baumé.

A recent development of oil-burning engines in moderate sizes of the hot-bulb ignition type may be noted. These engines are attracting wide and favorable attention, especially in Europe. The compression pressures are moderate, not exceeding 200 lb., and the engine is simple in construction and moderate in first cost. While not equal to the Diesel engine in economy, the more ready adaptation to small sizes, the lower first cost in relation to power and the greater simplicity all represent advantages which may well justify their increasing use for many types of service.

In central-station design generally increasing recognition may be noted of the possibility of over-all economies by combining various thermal programs in series and rejecting the final residue of heat always at the lowest possible temperature. Thus if steam is required for heating or industrial purposes, such steam should be passed through a prime mover down to the pressure at which it is required and then tapped out. If all the steam passing through a prime mover could be so used, then the heat charge against power would be only the heat equivalent of the power generated. Again, where practicable internal-combustion exhausts may with advantage be utilized for heating water, making steam for heating or industrial use, keeping boilers warm, or even for generating power by low-pressure turbines. In brief, no stream of heat should be allowed to escape from a power house unless it is at a temperature too low to represent any possible salvage. This principle is gaining clearer recognition, and many illustrative applications have been noted in recent central-station design.

The Energy Transmission Work of 1914

By Louis Bell*

ON account of the impossibility of separating from the total mass of work that which is to be credited to a particular twelvemonth, one is able merely to run over the ground and make note of certain tendencies which have become more or less prominent during the period under consideration. For example, the tendency of transmission voltages has been clearly upward, although no actual sensational advances have been made. The top records belong to a group of three plants rated at from 140,000 volts to 150,000 volts. This range has hardly been more than touched experimentally, the full pressures not yet being required by the conditions of service. A larger group, above a score, operates at rated voltages of from 100,000 to 130,000. It is doubtful whether more than a dozen of these are worked day in and day out at above 100,000 volts, although all are ready to operate at their rated voltage when required.

An interesting feature in high-tension transmission is the diversity of practice with regard to transformer connections. Of some thirty plants, American and foreign, rated at 100,000 volts and over, more than one-half use the delta-delta connection and nearly all the rest the delta connection at one end and star at the other. Very few use the star-star connection which was once rather popular, but these few are rather important. The results seem to indicate that any of the connections is satisfactory in practice when properly installed.

As to distances of transmission now accomplished, it is not easy to make a proper classification. Three systems operating at the very highest voltage carry energy approximately 240 miles over practically straight-away transmission lines. However, when one considers the actual distances covered, the distance just named is often exceeded in the connected links of a network. For instance, one Southern network reaches practically from the Atlantic to the Mississippi, over a distance of roughly 1000 miles. As a physical network its range is thus prodigious, but from an electrical standpoint the network is fed with energy from several plants operated with a certain degree of independence. In other words, in this and similar cases of less extent, one does not encounter the typical line conditions pertaining to continuous conductors of the length described. There are several or many stations connected to the same network, energy is used in large amounts at many points, and the operating conditions are those of plants interconnected temporarily or permanently to assist each other in emergency. It is this condition which makes operation comparatively easy and greatly simplifies the problems of regulation.

The Big Creek System

One of the striking pieces of work in connection with regulation is the installation of a very large synchronous-condenser equipment at the receiving end of the Big Creek system, to control the 240-mile line. The plan of using variable excitation on a synchronous machine to control the voltage and the power-factor is an old one, dating indeed from the very first use of three-phase synchronous motors a score of years ago. But in the lengths of line ordinarily used acute conditions of capacity rise of voltage do not exist, an extreme case like that of the Big Creek system being required to make the scheme worth considering as a general method of automatic regulation. With 240 miles of line to deal with, the charging conditions are formidable and the terminal voltage is at times a matter of concern. With a pair of 15,000-kva machines floating on the line, inductance or capacity can be added at will, and in fact automatically, so that the voltage and the power-factor are under good control. The scheme is a costly one, as the capacity of the machine indicates, and whether the game is really worth the candle remains to be seen. In the Southern Sierras system of about the same length use is made of reactors at the receiving end to control the charging and light-load difficulties and obtain regulation in the ordinary ways. Certainly it would seem worth while to load the machines usefully if possible, unless the conditions are so severe as to call for the extremest efforts in regulation, which conditions exist only on lines far longer than either of the above.

Fortunately, no straight-away line not carrying in-

*Consulting engineer, Boston, Mass.

termediate loads has a length anywhere near the quarter-wave-length distance, so that the best method of dealing with a line of this length is as yet chiefly of academic interest. Usually loads at various points greatly modify the reactance and conductance conditions, so that the theoretical side of the case drops out of sight and is replaced by a symptomatic treatment based on things as they are.

Line Construction on Extensive Systems

Concerning line construction on long systems, there is to-day fair agreement as to sound standards. No line worked at 100,000 volts or more is carried on anything but suspension insulators, from five to ten disks being used as the pressure reaches or exceeds 100,000 volts. The conductors are always carried on steel towers usually 50 ft. to 70 ft. in height with spans averaging about 600 ft. and spacing generally from 8 ft. to 10 ft. The conductors are commonly of stranded copper, although it should be noted that in several very recent and important plants use is made of steel-cored aluminum cable, which seems to give excellent results.

One of the notable tendencies in practice is in connection with switching and substation work. Of late there have been installed many outdoor substations and numerous outdoor switches. In fact, in Southern and Coast plants this practice is almost usual. The high cost of oil switches for very high tension and the recognition of the fact that high-tension switches are opened under load only at rare intervals have encouraged the use of the simpler apparatus. That such a plan is theoretically open to criticism admits of no dispute, but it seems to give satisfaction to the users who have to deal with the practical conditions of operation.

As regards the very important matter of protection against lightning, the story of the year is one of regular installation of ground wires along the system and of aluminum arresters at the important points, with a few horn-gap arresters for the more moderate voltages. However, it is noteworthy that at least two large systems are operated practically without lightning protection, perhaps on the theory that the protective devices are as hard to keep in order as are the lines themselves. Anyhow, not much has been heard during the year of serious trouble from lightning, so that the present methods may be considered to be reasonably effective.

Experimenting with Frequency

There has been little tendency of late to experiment with frequency. Sixty cycles per second is practically the standard as in the past, although one of the largest plants uses a frequency of fifty and another twenty-five. The last-named is that of the Lehigh Navigation Electric Company, very notable as being designed for the use of otherwise unmarketable coal. Starting off with some 50,000 hp in turbo-generators and transmitting energy at 110,000 volts, it comes nearer to the realization of the dream of "energy directly from the coal mine" than any enterprise yet inaugurated. The frequency selected in this case fitted conveniently the turbine design and permitted the economical use of direct-current motors at the receiving end of the line. In spite of the large amount of evidence showing that a well-organized steam plant on a large scale can actually furnish energy at a lower cost than most hydroelectric plants, capital seems shy about going into independent enterprises of this sort. The one here mentioned should soon be the forerunner of many another.

To summarize the transmission situation, it may be said that the year has been one of steady and healthy growth in electrical energy transmission, unmarked by anything sensational. In fact, there has been little of the sensational in the art since the introduction of the suspension insulator and the aluminum lightning arrester. Practice has fallen into sound lines, and with few exceptions the plants installed have been operated under circumstances which give promise of success from both the technical and the financial point of view. Perhaps the best tendency in the art is the increasing inclination to look upon a transmission plant as a conservative enterprise to be installed solely with a view to permanent dividends. The few failures which have occurred have been attributable to the neglect to take this sound and apparently self-evident view of the situation.

Developments in Illumination During 1914

By Preston S. Millar*

IN chronicling the events of 1914 in the field of illumination, the development and improvement of illuminants must receive first place.

Illuminants

The gas-filled tungsten lamp was announced in the autumn of 1913. Widely heralded as a half-watt lamp possessing all the simplicity and convenience of the incandescent-lamp type, it created an instantaneous demand from prospective users which the manufacturers found it difficult to meet. During 1914 it entered into commercial use, although at the end of the year it has not yet emerged from the developmental stage. The high temperatures at which it operates and the presence of an inert gas in the bulb have occasioned difficulties in the manufacture, testing and use of the lamp which have introduced problems not previously experienced with incandescent lamps and requiring time for solution. To the available sizes of the gas-filled lamps there have been added during the year 200-watt and 300-watt multiple lamps and series lamps of 60 cp, 40 cp and 32 cp, as well as a 400-cp lamp for operation with an auto-transformer upon a 15-amp circuit. Lamps range from a specific consumption of about 0.63 watt per mean spherical candle-power for the 1000-cp series lamp of 20 amp to about 1.25 watts per mean spherical candle-power for the 32-cp series lamp of 7.5 amp. In the multiple type the specific consumptions lie between the extremes of 0.72 watt per mean spherical candle-power for the 1000-watt size and 1.08 watts per mean spherical candle-power for the 200-watt size. The average gas-filled lamp as manufactured at the close of 1914 probably operates at a specific consumption approximating 0.9 watt per mean spherical candle-power, or at an output of 14 lumens per watt, this figure, of course, applying to a new bare lamp. This represents an increase in efficiency of about 40 per cent over the vacuum type of tungsten lamp of the same size available at the end of 1913. While the gas-filled lamp is supplanting vacuum-type tungsten lamps in the smaller street series sizes, it is of interest particularly as a competitor of the arc lamp.

Among modern arc lamps the long-burning flame-arc unit and the magnetite-type arc unit are chiefly to be considered. During the past year no material improvement in the long-burning flame-arc lamp has been reported, though there have been improvements in

*Past-president Illuminating Engineering Society.

electrodes and doubtless in minor details of construction bettering operation. In the magnetite type of lamp there have been improvements and extensions of the system. New electrodes have been produced by means of which the efficiency is increased something like 50 per cent over that of the standard type of electrode heretofore used. Moreover, the construction of the lamp has been modified somewhat, and a refractor has been made available by means of which a larger proportion of the light from the arc may be utilized. At the same time the available systems at 4 amp and 6.6 amp have been supplemented by a new system for operation at 5 amp. It is reasonable to say that the improvement in the magnetite-arc lamp during the past year parallels in time and extent the improvement in tungsten lamps due to the use of an inert gas in the bulb.

In the vacuum type of tungsten lamp improvements in manufacture have made possible an increase of about 10 per cent in efficiency during the past year.

The use of metallized-carbon lamps is diminishing rapidly, and plain carbon-filament lamps have practically disappeared from the demand.

No improvements have been reported during the year in commercial mercury-vapor lamps of either the low-pressure glass type or the high-pressure quartz type. Other forms of the tube lamps remain as before. Some interest was aroused last summer in the announcement of a "targon" lamp, this being a large incandescent lamp having a metal filament operating in an atmosphere of inert gas. However, there have been no commercial developments in this connection.

Considerable impetus has been given to the artificial-daylight movement by the development of the gas-filled tungsten lamp. Artificial daylight equipments are now available in the form of the Moore tube, intensified carbon-arc lamp with color filters, and gas-filled lamp with color filters. In all of these equipments the efficiency is very low and the lighting is so costly that it is practicable to employ it only for the illumination of small areas. Other approximation equipments are available for producing from gas-filled lamps a light which approaches daylight closely enough for some purposes at an efficiency which is not prohibitively low when the lighting of large areas is contemplated.

Lighting Auxiliaries

The year has witnessed a continued growth in the variety and use of lighting accessories. Sufficient time has elapsed since the earlier discussions of direct, semi-indirect and indirect lighting equipments to allow misconception to be righted, and it is now evident that all three forms of lighting have a place, but that in most cases extremes in any one of the three types are to be avoided. Hence modern forms of these three kinds of lighting have been designed with more or less the same principles in view and tend more than did the earlier examples to embody the same purposes to such an extent that the separation of lighting equipments into the three classes is no longer significant. Stock fixtures and glassware produced during 1914 probably attained higher merit than ever before with corresponding advantage in new lighting installations. Very little has been accomplished, however, in the remodeling of older installations other than those of a commercial nature where sales effectiveness is concerned, or of an industrial nature where production efficiency is involved.

The gas-filled tungsten lamp has introduced its own problems in lighting auxiliaries. The filament brightness is so high as to make use of some form of diffusing medium essential. It has created at the same time a demand for a ventilated fixture to keep down temperatures of the lamp itself in order to secure best life performance. For outdoor service these fixtures must be weatherproof as well.

Perhaps the most notable development in lighting auxiliaries has been the production of the prismatic refractor, applying the principles of prismatic glassware design to street lighting by constructing the globe with directing prisms and diffusing ribbings within a sealed chamber and presenting smooth exterior surfaces which do not promote the collection of dust or introduce difficulties in cleaning.

Lighting Practice

In comprehension of lighting fundamentals the principal advance during the past year has been in growth of knowledge with regard to contrast limitations. Avoidance of excessive brightness has been one of the leading tenets of illuminating engineering for a number of years, but a new appreciation of the importance of regulating brightness contrasts, even after excessively bright sources have been concealed, has been brought about by added experience and by the use of portable photometers in brightness studies.

Two significant developments in lighting practice during the year are "flood lighting" of buildings and the lighting for recreation purposes of outdoor places such as tennis courts, portions of golf links, etc. Both are made practicable by the availability of the higher-efficiency illuminants.

In street lighting the upward tendencies in intensities continue to manifest themselves, though in some cities the increase is considerably less marked than the increasing efficiency of illuminants would appear to warrant. Cluster lighting for "white ways" appears to have seen its greatest growth, single illuminants being employed in many of the more recent installations. The "ornamental" type of arc lamp has made notable progress, and the large globe installations in the city of Washington are especially noteworthy.

Central-Station Lamp Policies

Information from several sources including convention discussions makes it appear that in the modern view of most central-station men the control of lamps supplied to central-station customers should be in the hands of the central station. While there are notable exceptions to this general view, it is becoming increasingly apparent that no other course is consistent with the best lighting results and therefore with the best development of the companies' lighting business. In some cases tungsten lamps are being sold at list price, in other cases at cost price, and in some of the largest cities tungsten lamps of 60 watts and above are given in free renewals. It has been shown possible in various localities to control the supply of lamps by each of the methods indicated. That the central station should control the supply by some means is clearly indicated.

Photometry

The three principal developments of the year in photometry are progress in the production of color filters for heterochromatic photometry, progress toward the adoption of a flux rating instead of a candle-power for lamps, and increasing use of portable photometers in the study of illumination.

The gas-filled lamp has introduced problems not previously encountered in photometry. The simple solution of some of these problems requires a flux rating. For purposes of comparison with arc lamps the same requirement exists. Lamp manufacturers and users, as well as the technical societies, are rapidly coming to the view that nothing less than a flux rating will serve.

Standardization of heterochromatic photometry is in

a fair way of being accomplished, at least upon some arbitrary basis. It is understood that several laboratories, including the Bureau of Standards, are at work upon this problem and that the Illuminating Engineering Society is continuing the efforts begun in 1910 to facilitate the adoption of some form of standardization.

Engineering Societies and Research

For the first time in 1914 the Illuminating Engineering Society received more able papers than its *Transactions* could accommodate and was compelled to postpone the acceptance of some papers until a later date. It is further interesting to note an excess of scientific and research papers among those offered to the society. Both are indications of an excellent state of affairs in the field of illumination and augur well for further development in the near future. As the Illuminating Engineering Society is the official exponent of proper lighting practice in this country, it affords a means of testing the strength of the constructive forces in the field. The society's annual report indicates greatly extended activity along educational and research lines as well as intensified interest on the part of existing members. It fails to record an increase in membership which its activities and the general interest in the subject would appear to warrant. Its progress appears to be derived from the expanded activities of a membership of 1500, which has remained stationary for the past three or four years.

There are now four or five laboratories in the country engaged in organized research in the field of illumination. Numerous individuals are conducting less completely organized investigations. All work thus accomplished tends to find an outlet through the *Transactions* of the Illuminating Engineering Society. These *Transactions* include as well practically all that is significant in advance in lighting practice and are accordingly becoming more valuable and extensive year by year.

The United States national committee of the International Commission on Illumination has organized for effective work. As all international effort has had to be suspended temporarily, but little further progress has been made.

The Incandescent Lamp Industry

By S. E. Doane*

THE policies of retrenchment and conservation of resources so generally adopted throughout this country upon the outbreak of hostilities abroad caused sales of incandescent lamps for this year to fall somewhat below the expected value. The reduction in sales has been due principally, I believe, to the reduction of lamp stocks in consumers' hands and to the fact that lamp consumers have allowed their lighting installations to deteriorate to a point somewhat below the normal level. Burn-outs are not replaced as quickly in many instances as heretofore, the change-over from carbon to tungsten lamps has been retarded, and lamps are allowed to remain in service longer than has been customary.

I have discovered in conversation with many central-station men that throughout this period there has been a very considerable increase in connected load without a corresponding increase in maximum demand or output. This would possibly indicate a restriction of the use of light in certain industries or businesses which have been forced to operate under their normal rate.

While all this has reduced the demand for lamps during the past few months, a large part of the apparent loss will be made up as conditions assume their normal state and as lamp stocks are again replenished and lighting installations overhauled. The rate at which new sockets are being added at present will assist in rapidly bringing up the lamp demand with further improvements in general conditions.

The lamp industry is storing up, as it were, a vast amount of potential business energy, which will be converted into the kinetic energy of actual sales just as soon as the present temporary restriction on its outlet is removed.

Electrochemistry in 1914

By E. F. Roeber†

THE work of the electrochemist is directed toward two aims. One is the production of electrical energy from chemical energy—that is, the field of the primary battery and the storage battery. The other is the production of chemicals and of chemical effects by electrical means, the storage of electrical energy in chemicals for "chemical energy transmission."

There is not much to be said about primary batteries and storage batteries. In the past year, as for a long time, no radically new or revolutionary advance has been made in this field, but the battery industry has been in quite a satisfactory condition, and, as is natural in a field which has become more and more standardized, progress has been made quietly along the lines of perfecting details and methods of application.

Such progress as has been made is to be attributed to the electrical engineer rather than to the electrochemist. This remark emphasizes the fact that the old problem of the "carbon cell" is still unsolved. In view of its importance a concise statement of the problem may not be amiss here. Commercial primary batteries are essentially based on the use of zinc as "fuel." But there is not the slightest chemical reason why this should be so. As a matter of fact, cells with iron as "fuel" can be built and have been built. But the favorite visionary problem of electrochemists has been to substitute carbon for zinc and devise a carbon cell. An analogy exists in the ordinary Daniell cell. The chemical reaction utilized in it is the reaction between zinc and copper sulphate, yielding zinc sulphate and copper. This reaction could be brought about by placing zinc directly in the copper sulphate. The reaction then proceeds, but all of the reaction energy appears in the form of heat. In the Daniell cell an entirely different arrangement is used. The zinc is not placed directly in copper sulphate, but the utmost care is taken to keep the two away from each other. Zinc is used as one electrode and copper sulphate is placed around the other electrode, so that

*Chief engineer National Electric Lamp Association.
†Editor *Metallurgical and Chemical Engineering.*

the reaction between the two is not direct, but, as Ostwald calls it, a "chemical action into the distance" through the intermediary of ionic migration. The result is that when the reaction proceeds the reaction energy is obtained not as heat but as electrical energy.

Consider now the analogous problem for the combustion of carbon. At present coal is burned under boilers used in connection with steam engines and generators to produce electrical energy by a roundabout method with a low efficiency. There would be no corresponding limitation with a carbon cell, in which the combination of the carbon with the oxygen would be brought about not by direct contact and therefore without producduction of heat, but with direct production of electrical energy. The trouble is that a cell arrangement which would represent the carbon analogy to the zinc cell has not been discovered. The carbon cell is still a dream. Theorists and practical men have attempted the solution of the problem, but have failed equally here and abroad. It seems appropriate here to emphasize that if this problem has a solution its discovery would mean the greatest revolution possible by electrochemistry not only in electrical engineering but in the whole industrial system of the world.

Chemical Production by Electricity

From this, the greatest disappointment which must be recorded in the past development of electrochemistry, we may well turn to the other problem of producing chemicals and chemical effects by electrical means. In this field the last two decades have witnessed an unbroken series of glorious successes; of all American chemical industries none is more specifically American, made and born in the United States, than the American electrochemical industry. There are very few imported processes in it. As a monument to this activity are the large and firmly established industries of aluminum and sodium, artificial abrasives, artificial graphite, calcium carbide and chlorine, electrolytic copper refining, etc. During the past year all of them made quite steady effective progress along conservative lines until the European war broke out. None of these industries has been shaken in any fundamental point by the war, although the general commercial situation created by the war has affected some of them more or less, especially by cutting off the export trade. Most notably affected has been electrolytic copper refining, like the whole copper industry, because with an export trade equal to the home consumption it has been necessary to cut the production in half. On the other hand, electrolytic caustic soda and chlorine plants have profited by the cutting off of imports of bleach from Europe, and the sole American manufacturer of calcium cyanamide, who formerly sold the cyanamide exclusively for fertilizing purposes, is now erecting a plant for the production of other chemicals from cyanamide as the starting material.

Developments Along New Lines

Electrochemical developments along two distinctly new lines deserve at least brief mention. While not many years ago the hydrometallurgy of copper was regarded with suspicion, now the tables are turned and some of the best talent in the country is engaged in experimental work on the leaching of low-grade copper ores and tailings, with reasonable prospects of success. As to the precipitation of copper from solutions, opinions seem to differ most. Electrolysis, hydrogen sulphide and metallic iron are the three precipitating agents thus far proposed and used. One of the largest undertakings of this kind is the plant under erection by the Chile Exploration Company, in which electrolytic precipitation will be employed with magnetite electrodes.

The second interesting development is in connection with industrial applications of electrostatic principles. To electrostatic ore separation has been added the electrostatic precipitation of dust or any solid or liquid particles from gases. While originally designed for cleaning obnoxious smelter fumes, the Cottrell process is finding application in a much wider field. Only a few instances may be mentioned—the precipitation of sulphuric acid mist, the collection of abrasive dust, cement dust, etc., the recovery of gold and silver particles from the fumes of slime furnaces in copper refineries, the detarring of illuminating gas and producer gas, etc.

Again it may be pointed out that these two new broad and important developments are distinctly American.

Review of the Electric-Vehicle Field

By William P. Kennedy*

UNDER the conditions that have prevailed in the business world during the past year progress in the introduction of electric vehicles has naturally been somewhat restricted. The restriction has been less pronounced in the passenger-vehicle field than in that of the commercial car; as a matter of fact, the progress made with the former type of machine has afforded considerable encouragement in a situation which would otherwise have undoubtedly presented many hardships.

Trial periods of this character enforce severe tests upon the stability of any industry, and it is particularly interesting to observe that the electric-vehicle business is so conservatively organized that it can adjust itself to sub-normal conditions following a term of somewhat unusual expansion. Another assurance toward larger development following the present reduced activity is that, notwithstanding the immediate low returns, there has been considerable preparation of an organizing and constructive character to broaden the missionary efforts very evidently necessary to make the public recognize the superior advantages of this type of machine in business or personal service.

The extension of the Electric Vehicle Association of America is particularly significant. It has more than doubled its membership and has established sections in every important center of the country. The activity thus generated in widely separated localities which have heretofore been dormant on the subject of electric-vehicle expansion is certain to have a great cumulative effect upon the industry. Co-operating along similar lines are the National Electric Light Association, the Society for Electrical Development, Inc., the Ohio Electric Light Association and the Southwestern Electrical and Gas Association, which are exerting a particular and valuable effort to enkindle interest and broaden the sphere of influence in the general project of increasing the use of electrically driven conveyances.

Vehicle Development

The progressive development of the vehicle has not abated in the least. During the year efforts were exerted by many manufacturers to put upon the market new models of both passenger and commercial machines

*Consulting transportation engineer, New York.

which would specifically meet requirements indicated by the demand in new directions. With passenger vehicles there are new designs particularly serviceable for men's use, as against the closed-carriage designs preferred by women. Some reductions have been made in the weight and price of closed carriages without seriously curtailing the luxurious equipment still desired by those who prefer elegance and refinement. With the downward trend of the price of gasoline passenger cars the electric carriage is becoming more distinctively exclusive and is likely to satisfy the permanent demands of that great proportion of our communities who have the ability and inclination to select the more refined types of any convenience in general use. The majority of experienced manufacturers therefore continue to exploit their business in the direction of the high-priced car, instead of pursuing the phantom demand in the opposite direction, to which much attention has been directed during the past year. Much has been said as to prospective accomplishments with the low-priced passenger cars, but there are so many obstructions to manufacturing or marketing the quantities necessary to make this a profitable reality that no serious effort has been made in such a development.

With commercial machines the conditions are somewhat different, as the market is assured by economic considerations, and the production of low-priced cars is becoming more and more feasible with the growth of the automobile industry at large. As a matter of fact, some actual progress has been made during the year in this direction and the volume of business secured seems to accelerate rapidly as the project advances.

As to the modification or improvement of electrical or mechanical equipment in general, little change has taken place. The worm type of driving gear has gained a little in both the commercial and passenger field, by virtue of a desire for smooth, quiet operation and inclosed mechanism rather than from any necessity or from any scope for marked improvement. Body designs in the commercial types, particularly in the lighter sizes, are gradually assuming a distinctly artistic appearance. Refinements of this kind, easily possible with electric delivery vehicles, render them increasingly popular among the better class merchants, who consider the appearance and performance of their delivery equipment an advantageous means of business extension.

Manufacturing Methods

Among manufacturers the question of more complete standardization of equipment and parts has recently been under consideration in a very energetic manner. Many of the unnecessary irregularities can be eliminated with material advantage to both the maker and the user. Limitation in the variety of wheel sizes is already a recommended practice. This alone will have a marked influence on tire price and tire operating expense. Standardized practices will very shortly be applied to the number of cells in batteries employed in both types of machines, with such grouping of these cells in trays as to provide for a wide range of interchangeability which will be of particular advantage in large commercial installations. Lack of this interchangeability results in considerable excess investment in spare equipment, and anything which may be conducive to lowering the operating cost of large installations will tend materially to expedite the more extensive use of electric vehicles.

Operating Costs

There has been unusual activity during the year to obtain definite information concerning the operating cost of commercial machines. The necessity for authenticated data arranged in such form as to be serviceable for comparative purposes has become so accentuated that several agencies are at work making compilations which will acquaint the user with his own operating expense as well as render the results developed available for promotion purposes. Many owners have been made to realize that their system of accounting is inadequate, and many who have properly recorded their expense but who have been reluctant to make it available beyond the limitations of their own organizations have been persuaded to assume a broader attitude. They have begun to realize that in this field, as in others, a manifestation of the experience of many in the cost of operating industrial equipment usually results in developments which have, retroactively, an advantage to those who aid in such movements. Consequently, the time is not far distant when the cost of operating each size of electric vehicle will be well known and universally accepted.

Low Rates

There has been a steady decline in the rates for electrical energy, the decrease being about 25 per cent generally throughout the country. This fact constitutes a strong inducement toward the use of electric vehicles, because the tendency of the price of fuel for gasoline machines is in the opposite direction. In New York City the minimum purchase of energy necessary to secure the low rate has been reduced from $25 to $10 per month, thereby practically opening the door of electric-vehicle use and economy to the owner of small transportation equipment. An associated move has been the persuasion of livery-stable keepers to furnish accommodation for small vehicles, with individually metered energy supply, thereby permitting the small butcher or baker to use electric delivery cars at such cost as has heretofore been possible only in large installations.

Municipal Service

For municipal employment, and particularly in street-cleaning service, the electric vehicle is beginning to receive serious consideration, and one may expect within the near future some developments which will be interesting and profitable. European cities have been in the advance in this direction, and the economy obtained has finally induced consideration of similar applications here. New York is taking the lead in a large way by setting aside a sufficient appropriation to equip completely one section of the city with practically all electric motor-vehicle apparatus. As this proceeds it will probably be well advertised and will attract such attention from other cities that similar apparatus will be employed in many other localities.

Parcel Post

It may be said that in the parcel post service there is a large potential opportunity which if industriously pursued will yield a considerable number of quantity installations and which should be of advantage alike to the manufacturers of vehicles and the central stations in those cities in which such applications could be effected.

During the earlier part of the year a comprehensive campaign was instituted in a very general way to acquaint those associated with parcel-post operation in the various departments of the government, as well as the central stations, concerning the many advantages of electric-vehicle employment, and to urge co-operation between the government and the central stations. Explanatory literature which was prepared and distributed resulted in a general expression of willingness to promote the employment of this type of machine wherever it might be feasible to do so.

The earlier operation of parcel post developed the fact that many of the practices in use with mail matter would require change before a smooth co-operative

working of the system could be effected. One of these is the method of securing vehicular service for the different forms of transportation required in cities, and this has recently had consideration with recommendations for such modification in the proposals of contractors as will combine all vehicle service to be rendered under one contract. Heretofore separate contracts have been made for each separate division of transportation. The combination service will eliminate certain losses.

Invitations to bid upon this new character of vehicle service are at present being printed and will shortly be issued, covering the requirements for some thirty cities, in which the present service will terminate on June 30, 1915. This is a rare opportunity for those who are really interested in the project, and success will depend upon the degree of intelligence exerted to solve the problems involved. Opportunity for change of vehicle equipment comes only once a year, and unless prompt action is taken at this time by those interested the chance to do something effective disappears for a long interval, during which interest in the project is likely to lag.

Industrial Trucks

Increasing progress is being made in the substitution of small electric vehicles for manual labor at docks, terminals and warehouses, where little improvement in the methods employed has ever before been shown. The margin for reduction of existing expense is very large, as those who have already made use of the new equipment will willingly testify. It stands to reason, therefore, that as the missionary efforts of those engaged in this field become more extended the rate of increase in this specific application will become more pronounced.

The General Prospect

There need be no particular apprehension as to the ability of the passenger vehicle to continue to secure a fair amount of patronage from those who prefer it for its own inherent advantages, aside from any competitive consideration as compared with the gasoline type of passenger car. The volume of business which has been secured in the past may continue and will probably increase, but competition against the gasoline car is becoming more and more difficult as the refinement of the latter lessens the margin of advantage which the electric vehicle has enjoyed.

Competition of the Gasoline Truck

The immediate situation with the commercial car is more serious on account of the decline of the demand for any kind of motor truck in this country due to general business conditions. There has been produced in the electric commercial field a state of suspended animation and no one can foretell under what conditions resuscitation will take place. One serious competitive change is certain. The gasoline-truck manufacturers are gaining an experience in the interval which places them on a better footing than ever before. Until very recently they did not receive such large quantity orders as the electric-vehicle manufacturer enjoyed. The quantity orders placed during the last few months by foreign governments with our gasoline-truck manufacturers give them an enormous advantage. Many of them are clearing their factories of all stock which they have had on hand, and the new experience gained in actually producing large lots on single orders will put them in possession of information they have not previously had. The net result to be expected is the lowering of prices all along the line and a new eagerness to secure the quantity business for which their appetites have been whetted, so to speak. The electric-vehicle manufacturers may thus be more seriously handicapped than ever, and it will require some extraordinary effort to keep the business from becoming decadent.

Merchandise transportation in the large cities will be handled completely by motor vehicles within ten years. It has taken less time than this to bring about the almost complete change now accomplished in passenger transportation. During the next few years the relative position of the two competing types of machines for this service will be determined.

Radiotelegraphy and Radiotelephony

By J. L. Hogan, Jr.*

DURING the year 1914 the development in radio transmission seems to have been in the direction of extending the application of well-known fundamentals of practice, rather than in the adoption of any radically new methods or apparatus. Marked advances in the technique of long-distance radiotelegraphy have been made, and even in the less important instruments used normal and satisfactory progress in design has been shown. As would seem natural, the great European conflict has already forced the completion of valuable service improvements, but it has also put an end to equally or more valuable researches into many radio problems.

Safety at Sea

The lives of nearly 1000 persons saved from some ten merchant vessels by radio-directed rescue forces may be added to the already long list to the credit of this potent factor in increasing safety at sea. The value of federal licensing and inspection of radio stations has been further demonstrated by the discovery of a number of violations of the existent "wireless" laws and prosecution of the offenders, who often are not only guilty of legal misdemeanors but also of infractions of a common moral duty toward passengers aboard their vessels. Notable progress has been made in the adoption of well-designed auxiliary radio transmitters, supplied with power by special installations of storage cells and capable of sending distress signals some 200 miles under usual daylight conditions, to take the place of the feeble induction-coil plain-aerial emergency senders which were almost universal a year ago. Many ships, however, have insufficient storage-battery equipment, or even none at all. Any of these may at any time increase the number of vessels which have sunk "before the S. O. S. call could be sent out," since as soon as the engine room is flooded power from the dynamos is cut off and the radio equipment is most effectively gagged.

Radio Signaling on Trains, Submarines and Aircraft

In its application to signaling to, from and between moving trains, radio has found another field of usefulness. During the past year it has been demonstrated that a small power transmitter installed in an ordinary railway coach and using a low horizontal aerial of wires strung along the roofs of adjoining cars can be relied upon to telegraph some 50 miles. The installations which have been made, however, have not been operated continuously, perhaps since the expense of maintaining a trained telegrapher for each train more than offsets the convenience of such equipment. Elimination of the

*Chief research engineer National Electric Signaling Company.

"fixed charge" in operator's salary may be the result of some experiments in wireless telephony to and from trains which are now being planned, since if speech can be satisfactorily transmitted and if the apparatus prove reasonably rugged in service, the train crew can be depended upon for handling messages.

Similarly, the use of radiotelegraphy upon submarines and aircraft is growing from day to day. The large Zeppelins are said to be equipped with instruments giving possible operating ranges of several hundred miles, and aeroplane installations capable of signaling some 50 miles are not thought unusual. The distances reached from submarine boats are of this same order, and for exchange of messages under some conditions when wire aerials could not be erected submarines have used as antennas jets of salt water pumped vertically into the air and "insulated" from the sea by passing through spiral tubing forming the coupling coil.

Long-Distance Communication

In competition with and as a substitute for line and cable telegraphy over long and short stretches of sea, radio has become of still greater importance. Early in the year the cable to Nassau, in the Bahamas, was interrupted; and since excellent service to that island has been given from the wireless station at Miami, it is anticipated that the cable will not be replaced. Radio transmission over this short link of about 180 miles is not, however, to be compared to the wireless communication direct between the United States and Germany, some 4000 miles, which has existed to some useful degree ever since the cutting of the Emden cable near the Azores, and which now permits regular exchange of commercial messages by way of Tuckerton, N. J., and Eilvese, near Hanover. At the time of enforced cessation of cable service direct with Germany these two plants had just about completed their experimental transmission tests and were preparing to open for the sending of paid messages. Some complications of title and censorship then made it desirable for the federal government to take over the operation of the Tuckerton station, and public service in competition with the indirect cable routes was begun. The radio service was interrupted by an unfortunate accident to the Tuckerton radio-frequency alternator, and although temporary communication was obtained by the successive installation of two arc generators of the type in use for signaling between San Francisco and Honolulu, regular service could not be had until a new alternator received from Germany was put in operation early in December.

During the same period of several months good transmission was had from the powerful station at Nauen, near Berlin, to Sayville, L. I., by the use of continuous waves, though the Sayville spark sender proved too feeble to reach Germany reliably. It is stated that the Sayville plant is now being equipped with a sustained-wave generator similar in size and principle of operation to that at Nauen, and therefore there probably will soon be two pairs of radio stations linking the United States and Germany. The fact that reasonably good interchange of messages is effected at the present time, however, must not be considered an assurance that the communication will extend through the summer months of severe atmospheric disturbance. It is, nevertheless, a great advance in radio practice to operate an actual commercial day and night service over some 4000 miles of sea at any season.

The completion of the powerful duplex spark telegraph installations at New Brunswick, N. J., and Carnavon, Wales, about 3300 miles apart, is of interest. These stations have not been opened for the handling of public messages, since the Welsh plant is held by the British government, but it is stated on good authority that messages are interchanged with such ease that they may be phonographically recorded at high speeds. A pair of similar stations at Koko Head, Hawaii, and near San Francisco are in operation and compete for public messages with the Pacific cables and the sustained-wave arc-generator radio service which was established several years ago over this span of approximately 2000 miles. The Clifden-Glace Bay service between Ireland and Nova Scotia has been duplexed, and although somewhat limited in operation by reason of strict government supervision, seems to be working satisfactorily.

In seeking the solution of problems involving long-distance transmission through severe interference from "static" and from external stations, engineers are steadily working toward sustained-wave generation by arc or machine alternator combined with receivers depending upon the "beats" or heterodyne principle. Several types of high-powered generators of sustained radio-frequency alternating current are in use, but each appears to have definite commercial disadvantages. It is hoped that these defects will be overcome during the next few years, and work is proceeding with that end in view. The musical-tone persistence-selecting receiver involving the production of oscillations at the receiving station and their combination with the incoming signals to cause amplified responses has become generally known only recently, but is already largely used for long-distance working. During the past twelve months the varied phenomena of gas conduction have been applied to an interesting group of amplifiers and low-powered oscillation generators, and the several gaseous detectors have found wider use than in previous years. It must constantly be borne in mind, however, that nothing is to be gained by unduly increasing the sensitiveness of receiving instruments, since their responsiveness to atmospherics (the real bane of the long-distance radiotelegrapher) is likely to become disproportionately great.

The Patent Situation

A large number of radiotelegraph and radiotelephone patents were issued in 1914, but by far the majority of them appear to have been granted on early applications for improvements in detail which have little if any current value. Patent litigation has been quite general; basic claims of Marconi and Fessenden have been broadly upheld and injunctions issued. It appears that for a time the federal courts will be kept busier than ever, since a number of new and unlitigated patents have recently been thrown into the group which are alleged to be infringed. The criminal courts have not been called upon to consider any further cases involving fraudulent stock manipulation and the like, so it may be considered that the earlier convictions have acted as a warning to those who delighted in exploiting the public's propensity to invest in romantic and mysterious pseudo-bonanzas.

The problem of radiotelephony is still to devise instruments capable of impressing vocal modulation upon large amounts of radio-frequency power. The sustained waves necessary for long-distance wireless speech transmission can be generated with comparative ease, but no controlling apparatus has been demonstrated. Short-distance telephony using substantially continuous waves generated by sparks occurring at group frequencies of the order of 5000 per second has received some little attention, but is limited in application by its dependence upon microphones for modulation. Until more satisfactory devices for the impression of the speech-wave "envelope curve" upon the high-frequency radiation can be produced there is little hope of long-distance radiotelephony or, in fact, even reliable voice signaling over moderate distances.

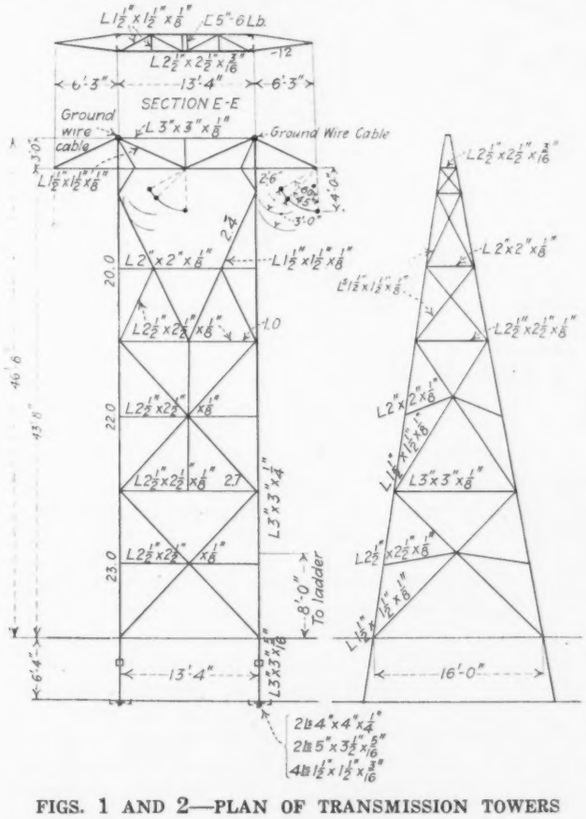
High-Voltage Transmission at High Altitude—I

The Chile Exploration Company's 110,000-Volt Installation at Chuquicamata in the Andes, Reaching an Elevation of 10,000 Ft.

BY PERCY H. THOMAS*

ONE of the most notable of the large engineering enterprises now being actively developed is the huge copper reduction plant of the Chile Exploration Company at Chuquicamata, Chile. This installation is situated high in the Andes Mountains, at an elevation of over 9000 ft., in a district practically a desert for many miles around. Here the company possesses an enormous deposit of low-grade copper ore which is to be treated on an unusually large scale. The Chuquicamata ore is of such a nature that it may be treated with acid or "leached" without previous roasting or smelting. The recovery of the copper from the resulting solution is accomplished by electrolysis, which operation serves at the same time to purify the product. It is expected that the copper thus electrolytically produced will have an electrical conductivity exceeding 100 per cent as compared with the Matthiessen standard. Obviously, for the electrolyte process there must be provided a large amount of electric energy in the form of direct current. It has been estimated that to deposit the copper contained in 10,000 tons of ore to be mined each day will require approximately from 60,000 amp to 70,000 amp at 235 volts with the equipment operating continuously for twenty-four hours daily.

There being no reasonably cheap fuel in that part of



FIGS. 1 AND 2—PLAN OF TRANSMISSION TOWERS

Chile, the most satisfactory and reliable source of energy has been found to be fuel oil burned under boilers at the seacoast. Electric energy generated therefrom by steam turbo-generators is to be transmitted over a 110,000-volt line to the mine. The purpose of the present article is to describe some of the more interesting features of this transmission line.

The generating station at Tocopilla on the seacoast is distant by 87 miles from the mine substation at Chuquicamata, the altitude of which is approximately 9000 ft. The generating station and substation and the apparatus in the stations were designed, built and installed by the Siemen-Schuckertwerke of Berlin. The generating station contains four 10,000-kva, 5000-volt, fifty-cycle turbo-generators and four three-phase, 10,000-kva transformers to raise the pressure to 110,000 volts. The normal load on the line will be approximately 30,000 kva. During the initial development stage it has been decided to install only a single three-wire circuit, which

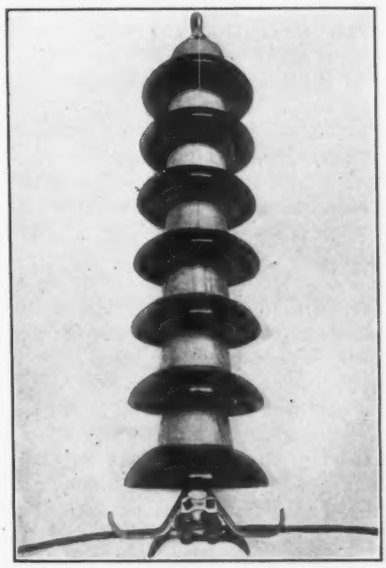


FIG. 3—ARRANGEMENT OF INSULATORS

is sufficient for transmitting this amount of power with about 7.5 per cent loss. Later there will be installed a second circuit carried on a second line of towers. In the substation are seven 2500-kw motor-generator sets, three being equipped with synchronous motors and four with induction motors. Each motor drives two direct-current generators, each having a maximum current rating of 6000 amp.

The transmission line is unique in passing from sea level to an elevation of 10,000 ft. Moreover, it traverses for its full length a country utterly barren of all vegetation or animal life. That is the "nitrate district" of Chile, and the line passes in the neighborhood of some of the present workings. While the barrenness eliminates certain difficulties in operation such as the falling of limbs of trees across the line and malicious interference, it leaves the line unprotected from the free sweep of high winds and exposed to dust deposits.

Physical Structure of the Line

Use is made of galvanized-steel towers with a standard span of 200 m (656 ft.), giving five towers to the kilometer, or about eight towers to the mile. The three conductors of No. 000 seven-strand medium hard-drawn copper cable, lie in a horizontal plane and are separated by 12 ft. 11 in. Two ⅜-in. galvanized Siemens-Martin

*Consulting electrical engineer.

steel cable ground wires are used. The arrangements of conductors and ground wire, together with the appearance of the face of the tower, are shown in Fig. 1. The side view may be seen in Fig. 2.

In laying out the line there was assumed a maximum wind pressure of 30 lb. per sq. ft. on flat surfaces, corresponding to a velocity of 87 miles an hour actual and

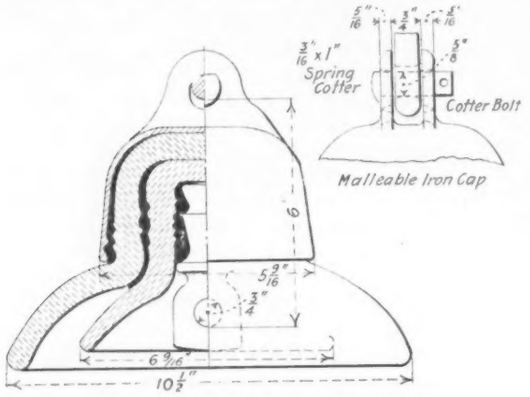


FIG. 4—SECTION OF INSULATOR

over 110 miles indicated. The assumed range of temperature was from —5 to +55 deg. C. As Chuquicamata is just under the Tropic of Capricorn and rain is practically unknown, no allowance was made for sleet. The stress permitted in the conductor with the maximum wind pressure on the cable as noted above is 2700 lb. at the temperature of —5 deg. C., giving a sag of 3 per cent in the standard span of 200 m with a temperature of 55 deg. without wind. The elastic limit, as determined by tests on sample of the actual cable, is 4000 lb., so that there is a margin of 50 per cent over 2700 lb., which is sufficient to take care of injuries, joints and other variations without exceeding the elastic limit of the material. The ultimate strength of the cable is 7000 lb., corresponding to 53,000 lb. per sq. in.

The ground-wire cable is stressed to 3000 lb. under the most severe conditions outlined above, giving 36,000 lb. per sq. in. The elastic limit of the cable was 4400 lb. or 53,000 lb. per sq. in. by test, and the ultimate strength was 9000 lb. or 108,000 lb. per sq. in. Thus

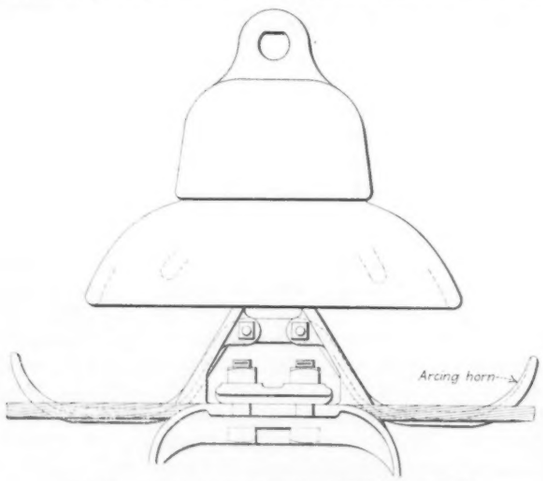


FIG 5—DETAIL SHOWING ARCING HORN

the line conductor has a factor of safety of over two and one-half and the ground wire a factor of safety of nearly three. These values should be compared with the factor of safety of two often used. The extra margin in the design is very desirable on account of the large output involved and the unusual importance of continuity in operation.

The line insulator used is of the Locke No. 3266 type, a new two-piece suspension insulator with a 10.5-in. outside diameter and a 6-ft. spacing. Seven units are employed in the suspension string. The insulator string is shown in Fig. 3 and the single unit in Fig. 4. Eight units are employed "in strain" where the line is dead-ended.

The regular or "standard" towers are 47 ft. high to the ground wire and 43 ft. 9 in. to the cross-arm. The base is 13 ft. by 16 ft. The towers are guyed at regular intervals on tangents and wherever desirable on angles. As far as practicable the tower construction has been made strong enough to stand without guys under any ordinary conditions of service, the guys being relied upon only for safety in case of extraordinary stresses. The line is transposed by a one-third turn at five points, there being two complete revolutions of the conductors.

Insulators

As the most important link in a transmission line, next to the conductors and the towers themselves, the

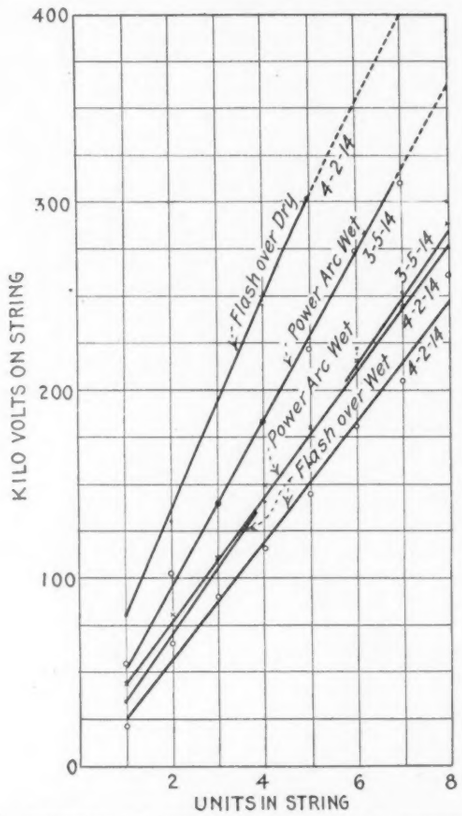


FIG. 6—RESULTS OF TESTS OF TWO-PIECE SUSPENSION INSULATORS

insulators require careful attention. The Chile Exploration Company's insulators embody a number of interesting features. Experience with suspension-type insulators during the last five years has brought out certain salient characteristics. As compared with the pin insulator, the suspension type gives the possibility of a larger margin of safety in insulation and permits the use of a far higher line voltage. Moreover, the suspension type offers several times the mechanical strength of the usual pin insulator and permits at least doubling the length of span. On the other hand, the suspension type has the great handicap of permitting the line to swing in any horizontal direction, As a result of this fact, combined with the necessity of supporting the insulator from above there is required a higher, wider and considerably more expensive tower than need be used with a pin-type insulator.

The disadvantage of mechanical swinging and excess tower cost attributable to the suspension insulator does not exist when the insulator is used as a strain unit, that is, with the axis of the insulator string in line with the cable. When such strain insulators are used the tower would differ little from that used with the pin-type insulator, although the greater mechanical strength of the suspension insulator would permit proportionally longer spans and heavier towers. However, the strain arrangement necessitates the use of two insulator strings at each point of support. In heavily constructed lines it would not be possible to use towers of as low a weight with insulators placed in the strain position as with insulators in the suspension position, on account of the partial relieving of the stress on a tower by the side deflection of the insulator string in case a wire becomes broken.

It has been stated that disk insulators in the strain position are more likely to fail electrically than when in the suspension position. It is very doubtful, however, whether a good porcelain insulator, properly designed and used, with a sufficient mechanical factor of safety, will have any less electrical strength in the strain than in the suspension position. However, on account of the disadvantage under which the insulator skirts act in the up-turned position of the strain insulator another unit is often added to the suspension string.

In the Chile Exploration Company's line use is made of the usual arrangement of suspension insulators for normal tangent portions that are reasonably level, but strain insulators are employed for dead-ending when any occasion therefor arises. The same type of insulator units are used in both positions, seven in suspension strings and eight in strains. The length of the suspension string, while greater than is often used, is short considering the unusually high puncture and surface resistance provided. The short length of string is greatly to the advantage of the tower mechanically, both in keeping down its physical dimensions and in reducing the amplitude of swinging of the conductors, thereby lessening the stresses and reducing the tendency of wires to come in contact.

Selection of Insulators

An outline of the conditions upon which was based the selection of the insulators for the Chile Exploration Company's line may be of interest. In the first place, the importance of the line and the great premium put upon continuity of service made reliability, and not insulator cost, the chief consideration. However, there is not so great a difference between the cost of the best and of inferior insulators as might be supposed. Had the cheapest insulator that could have been permitted from the most lenient point of view been adopted for this line, the actual saving in cost would have been from $5,000 to $7,000.

Mechanical and electrical ruggedness was made the prime requisite for the insulators. Mechanical reliability was insured by providing an unusually large factor of safety and by choosing the simplest and most favorable mechanical shapes. The two shells of which the insulator is made have no double or auxiliary petticoats and their outlines are smooth curves with very moderate maximum dimensions. The maximum mechanical stress expected on the insulator is 2700 lb. The insulator is guaranteed by the manufacturer for 10,000 lb., and the tests showed a strength averaging in the neighborhood of 12,000 lb. Manufacturing difficulties were reduced by not selecting shapes and proportions for the porcelain shells regarded as difficult or undesirable from the point of view of fabrication. It is to be noted that there are no thin edges or flanges on the insulators, the skirts being very heavy and strong. In order to reduce as far as possible any bursting effect from temperature expansion in the pin the cement received its initial set in an atmosphere of steam.

Electrical ruggedness was sought first and foremost by requiring a large factor of safety in the puncture resistance of the insulator over its flash-over voltage. In the actual insulator this factor was shown to exceed two as determined by the puncture test under oil as described below. Electrical reliability was sought by the use of a two-piece insulator, with the idea in view that if one of the shells should contain a defect not discovered in the routine factory tests the other shell would contain no such defect and the insulator would still be able to resist puncture at the flash-over voltage. Precautions were taken by inspection and tests as far as possible to insure careful firing and uniformity in the product. For this purpose special tests were made on selected lots of insulators from time to time as described below during the actual course of the manufacture to check the quality of the insulators actually coming through the factory.

It is believed that the above outlined method of selecting a high-tension insulator is more likely to lead to satisfactory results than the formal competitive test in which the principal stress is laid upon high flash-over voltage, upon the economical use of porcelain or upon corona phenomena.

The Chile Exploration Company's insulator is modeled after the well-known two-piece insulator used by the Southern Power Company and several other companies, but is so modified in its proportions as to have quite different characteristics. To prevent arcs that may result from flash-overs on the insulators from cracking the skirt of the lower insulator unit or burning the conductor, an arcing horn (shown in Fig. 5) is attached to the cable clamp, thereby offering a discharge gap about 1.5 in. shorter than the jumping distance from the ground to the insulator pin. This is believed to be a very helpful expedient, as many insulators capable of resisting puncture have been destroyed by arcing over.

The following factory tests were made on the Chile Exploration Company's insulators:

Routine Tests.—(a) On all shells as they came from the kiln and again on all cemented insulators voltage sufficient to produce occasional flash-overs (not oftener than once in two seconds) was applied for a period of two or three minutes, and the voltage was then raised somewhat to produce a practically steady succession of flash-overs, this latter adjustment being continued for one-half minute. The purpose of the two-minute period was to submit the porcelain to continuous sixty-cycle stress and the purpose of the one-half-minute period to produce an impact or "high-frequency" effect. The insulators stood up very well under the routine tests during manufacture. The percentage of electrical failures in the routine factory tests was unusually low, being 0.5 per cent on the small shell and 2 per cent on the large shell before cementing and 2.2 per cent on the finished insulator. The very small percentages were attributable, no doubt, in part to the high factor of safety in the design.

(b) All insulators were subjected for five seconds to a mechanical pull of 3000 lb., or 10 per cent in excess of the maximum strain expected in service. The mechanical pull was set far below the real strength of the insulator to avoid the possibility of injuring mechanically the insulators that were to go into actual service. It is believed, however, from some of the tests reported below, that at least double the above stress, or 6000 lb., might safely have been applied to the insulators. Not one insulator in the 18,000 tested failed under the 3000-lb. test.

Design Tests.—The curve of flash-over voltage, dry (shown in Fig. 6), was obtained in the usual manner by means of the manufacturers' test apparatus, reliance being placed on a needle-point gap to measure the voltage. No special attempt was made to insure the use of a sine voltage wave in this test.

In Fig. 6 is shown a curve of wet flash-over voltage obtained under the artificial condition of the rain test, which usually means little. Failure under the wet test is an uncertain and indeterminate phenomenon; it starts as a leakage of current and finally becomes a "power" arc with no definite or reproducible point of break-down between. The production of such a power arc requires an abnormally high voltage sustained for a certain period. Only under the rarest conditions can such a sustained high voltage be produced on a transmission line in service. To the other limitations of the laboratory rain test must, of course, be added that of the variation in purity or electrical conductivity of the water used. As a matter of practical experience little or no trouble is encountered in service from flashing over on line insulators on account of rain. This statement is applicable to rain, but it must be clearly understood that it has no bearing upon the effect of dust or salt deposits and fog, which may sometimes be very serious. As there is no known method of even roughly approximating in the laboratory the dust and fog conditions along any particular transmission lines, no attempt was made to predetermine the effect of the climatic conditions in Chile.

Uniformity Test. — The uniformity test originally proposed by Mr. F. W. Peek, Jr., as incorporated in the high-tension test specifications presented at the recent annual convention of the American Institute of Electrical Engineers, was applied to the insulators at four different times during the progress of the work with very interesting results. For carrying out this test twenty-two insulator units were selected at random from good insulators that had passed all routine tests. These were punctured under oil, the puncture voltage being carefully noted. The manufacturer was then permitted to cast out any two of the results and the re-

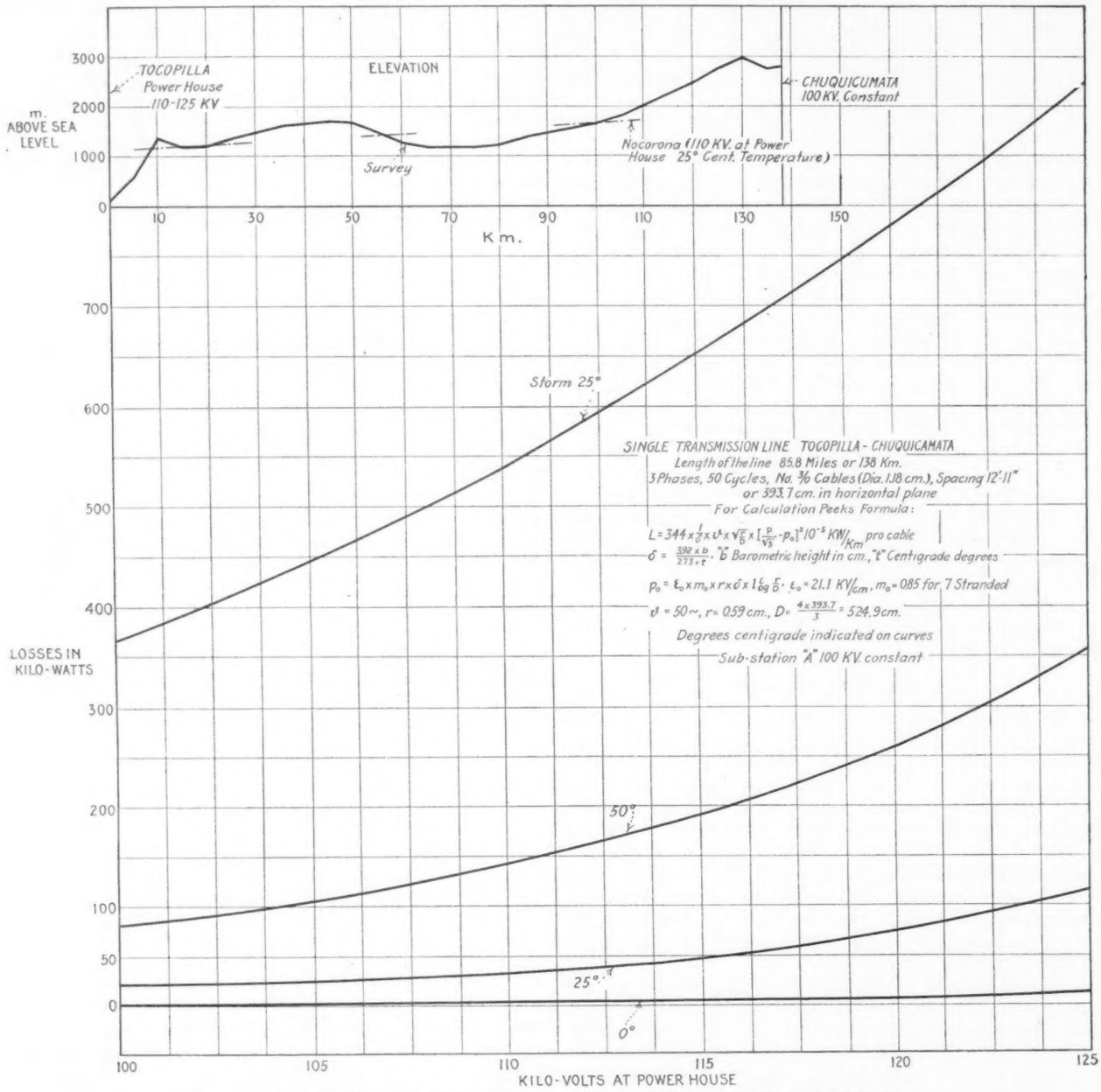


FIG. 7—CHART SHOWING CORONA LOSSES UNDER VARIOUS CONDITIONS

maining twenty were averaged. The maximum variation of puncture voltage between the highest and the lowest of the twenty remaining results was then not allowed to exceed 20 per cent of the average.

The reason that the manufacturer is permitted to cast out two of the twenty-two puncture values is that this test is intended to check the uniformity of the clay mixture and of the burning, and not to detect the occasional weak insulator.

In making the puncture tests the rate at which the voltage is raised is of the greatest importance, since the porcelain itself under an electric stress near the puncture point heats up very rapidly, the puncture resistance of the material being greatly reduced thereby. Since the high puncture resistance is desired chiefly against transient stresses which cannot last for a time sufficient to produce heating, the test voltage should be raised as quickly as is consistent with reliable readings. In the first uniformity test the test voltage was raised at the rate of approximately 1000 volts per second; in the later tests approximately six seconds were allowed to elapse from the time of passing from 30 per cent of puncture voltage to the full puncture voltage, the rate of increase being about 20,000 volts per second, although a little lower rate was used toward the puncture point. The results of the four uniformity tests were as shown in Table I.

TABLE 1—TEST OF GROUPS OF TWENTY INSULATORS

	First Test	Second Test	Third Test	Fourth Test
Mean puncture voltage	155,000	190,000	207,000	191,000
Maximum puncture voltage	170,000	204,000	222,000	208,000
Minimum puncture voltage	138,000	165,000	188,000	180,000
Maximum variation, per cent	20.7	20.5	16.4	14.7

The above puncture values are to be compared with the flash-over voltage of a single insulator, namely, 90,000 volts. The puncture tests were made on the regular testing apparatus of the manufacturer, and the voltage values were checked by the use of a needle-point gap. No claim is made to a sine voltage.

Impact Test.—Several impact or "high-frequency" tests were made on the unit insulators. Some of these tests were made in New York and others at the insulator factory. The tests were substantially like the test described before the American Institute of Electrical Engineers in a paper by Messrs. P. H. Thomas and L. E. Imlay in December, 1912. A large air condenser was caused to discharge across a considerable series gap onto the insulator under test, thereby providing an electric impact shock of the same nature as lightning.

The series gap in these tests was 20.5 in., equivalent to 200,000 volts, requiring for the discharge a transformer emf of 300,000 volts. The area of each condenser plate varied from 40 sq. ft. to 60 sq. ft., with a separation of plates of approximately 3 ft. No inductance other than that of the few feet of connecting wire was introduced in the discharge path from the condenser to the insulator.

Tests were made by applying single discharges or groups of discharges to the insulator with intervals of rest between to prevent the heating of the material of the insulator, this test being intended to be purely an impact test and not to involve the element of heating of the porcelain by repeated or sustained high-frequency stresses. The results of the test are shown in Table II. The last insulator was heated considerably during the repeated tests and the puncture may have been caused by the heating.

The impact test, which is new, is believed to give a good indication of the effect of transient or "high-frequency" voltages caused by lightning, which are so apt to puncture insulators. The insulators tested stood up well under the exacting test.

Mechanical Pull Test.—Several insulators were mechanically pulled to destruction, the stress as shown by a dynamometer being as follows: No. 1, 12,730 lb.; No. 2, 14,000 lb.; No. 3, 12,990 lb.; No. 4, 12,670 lb.; No. 5, 11,800 lb.; No. 6, 11,530 lb.; No. 7, 11,080 lb.; No. 8, 11,660 lb.; No. 9, 9590 lb.; No. 10, 9350 lb.; No. 11, 9490 lb.; No. 12, 11,060 lb.

TABLE II—ELECTRICAL IMPACT TEST OF INSULATORS

Insulator	No. of Shocks	Result
No. 1	200	No damage
No. 2	200	No damage
No. 3	17,500	No damage
No. 4	13,031	(Large shell punctured; had very slight blistering)

Insulators Nos. 9 to 12 failed by the pulling out of the pin; the cement had been set for only two days. Insulators Nos. 5 to 8 had previously been punctured and oil-soaked.

Omitting those in which the cement had set for only two days, the average stress at destruction was 12,310 lb. The noteworthy uniformity of the mechanical strength shown in these tests corresponds with the uniformity in puncture strength shown by the tests under oil.

Simultaneous Mechanical and Electrical Tests.—Several insulators were pulled to destruction mechanically while an electrical potential approximately flash-over voltage was simultaneously impressed on the insulators. Under these conditions the insulators will fail electrically as soon as any part of the insulator is injured by the mechanical strain. Under a test of this sort some types of insulators have been known to fail electrically after the application of perhaps one-third of their ultimate mechanical strength. The results obtained are given in Table III. These tests show that, at least for such mechanical stresses as were applied, the electrical strength is not greatly affected by mechanical stress.

TABLE III—SIMULTANEOUS MECHANICAL AND ELECTRICAL INSULATOR TESTS

No. of Insulators	Preliminary Electrical Failure, Lb.	Final Mechanical Failure, Lb.
2	11,000	12,000
3	11,000	11,900
4	11,000	11,600

Temperature-Expansion Tests.—In order to ascertain whether the design of insulator selected was able to resist considerable changes in temperature without cracking, two insulators were packed in snow for two hours and then immersed in cold water, which was gradually heated until the temperature reached approximately the boiling point. The insulators showed no signs of weakness after this treatment.

Shipment

These insulators were packed three or four in a crate and were shipped without additional precautions other than the use of extra heavy crates with iron hoops on the ends. No breakage during shipments has been reported.

Corona

As the Chile Exploration Company's line reaches an altitude of approximately 10,000 ft. and operates at from 100,000 volts to 110,000 volts, the corona loss must be most carefully considered. A study was made of the existing data on the subject, and calculations were finally made by means of the formula derived by Mr. F. W. Peek. The results were then compared with the published results on the Central Colorado Company's line, which is very similar thereto in many features. (See Mr. G. Faccioli's A. I. E. E. paper.) The Peek formula values are plotted in Fig. 7 covering the whole line under various conditions of temperature and line voltages. From these curves it is seen that the size of wire chosen, No. 000, is about as small as could be safely used.

The great influence of atmospheric temperature on the corona loss is readily seen from the curves. This effect of temperature is not always recognized in spite of its importance. On the other hand, the importance of keeping the line voltage below the critical corona voltage is often over-estimated. The loss under what Mr. Peek calls "storm" conditions also is shown: this term refers particularly to precipitation.

The conditions on this line are especially favorable for low corona loss on account of the wide spacing and the horizontal arrangement of the conductors. It is interesting to note that the horizontal arrangement as compared with the delta arrangement shows a lower corona loss, just as it shows a reduction of about 4 per cent in the capacity of the line. The lesser corona loss and lower capacity result from the fact that the two outside wires considered as a pair are twice as far apart as are the other pairs.

Electricity for Sterilizing Purposes

BY W. B. UNDERWOOD

New uses for electricity in hospitals are continually being found, but only within the past three or four years have any successful attempts been made to heat

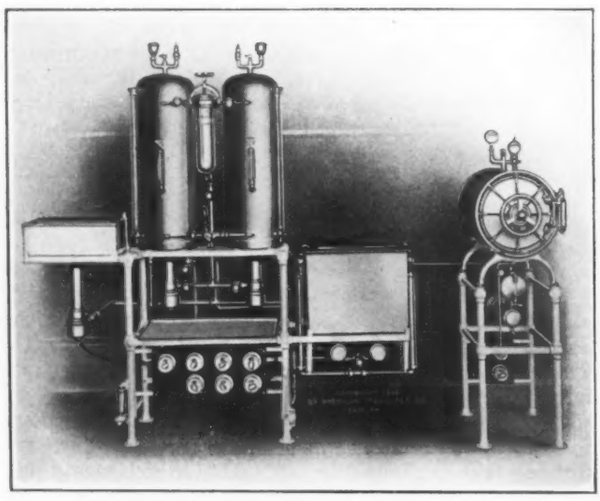


FIG. 1—BATTERY OF ELECTRIC STERILIZERS

steam-pressure sterilizers by electricity. Electric sterilizers are especially well adapted for use in institutions such as insane asylums, emergency operating departments of industrial plants, surgeons' private operating rooms, etc., where the apparatus is more or less infrequently employed. They are also useful in hospitals where a limited amount of steam is available.

Steam sterilizers may be heated by a central-boiler system, electricity, gas, kerosene, gasoline or alcohol. The latter three fuels are in the emergency class and are never used if any other fuel is available. Gas is objectionable because of unavoidable fumes and dirt and because of the danger of the water in the sterilizer evaporating and therefore destroying the apparatus.

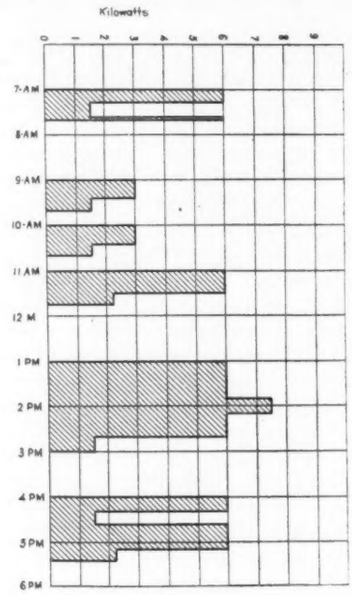


FIG. 2—AVERAGE DAILY ENERGY CONSUMPTION

It is said that, with some types of apparatus, gas at $1 per 1000 cu. ft. is equivalent to electricity at 1.5 cents per kw-hr. It is probable that this comparison approximately holds good on new apparatus when the efficiency of the gas heaters is a maximum. As the apparatus grows old, however, lime and sediment deposits seriously retard the passage of heat, and as a result it is not unusual to find that the time for heating a sterilizer after a year or more of service is more than doubled.

In the accompanying illustration is shown the electrically heated sterilizing equipment recently placed in the De Graff Memorial Hospital, North Tonawanda, N. Y. This is a typical installation, and the total rating is 27 kw, although usually a maximum of only 12 kw is taken. The apparatus consists of an instrument sterilizer, a utensil sterilizer, a pair of water sterilizers and a dressing sterilizer.

The instrument sterilizer consists of an electrically heated reservoir for boiling water. The surgeon's instruments are kept in this water for fifteen minutes before using. The device takes from 3 kw to 6 kw. The utensil sterilizer is made up of a larger reservoir than that used with the instrument sterilizer and is used for pans, basins, etc. It takes from 6 kw to 12 kw. The water sterilizers consist of two reservoirs, one being used for cold water and the other for hot water. To sterilize the water it is subjected to a temperature which corresponds to a steam pressure of 15 lb. to 18 lb. per sq. in. The maximum rating of each reservoir is 3 kw to 18 kw. The dressing sterilizer is a steam-jacketed cylindrical chamber for sterilizing bandages, dressings, etc. These materials usually are subjected to moist steam at a pressure of approximately 15 lb. per sq. in. for a period of about twenty-five minutes. The maximum rating of this device is 3 kw to 12 kw.

In each of these sterilizers the process is purely one of heating water. The heating units are interchangeable. The accompanying diagram shows the average daily energy consumption in a hospital equipped with from fifty to seventy beds.

DIGEST OF ELECTRICAL LITERATURE

Generators, Motors and Transformers

Synchronous Motor-Generator Versus Rotary Converter.—HUGO RING.—The author discusses the question whether the increasing tendency to favor the synchronous converter as a substitute for the synchronous motor-generator is justified. He first emphasizes that a synchronous motor-generator can easily be operated with other direct-current generators; moreover, the power-factor is adjustable and, independently of this, the direct-current voltage is also adjustable without any further auxiliary devices. For the same purposes the synchronous converter requires the use of various auxiliaries. With a synchronous converter it is necessary to know far more accurately in advance the detailed conditions of operation than with synchronous motor-generators. When installing a synchronous converter it would be fatal to hope that any defects may be remedied later by means of a choking coil or an auxiliary compound winding. In this case wattless current plays a rôle in the operation and the synchronous converter may be subjected to an overload for which it was not designed.—*Elek. Zeit.*, Nov. 5, 1914.

Lamps and Lighting

Train Lighting.—EMIL DICK.—The first part of an illustrated article on the electric lighting of passenger trains by the simplified Dick system. The illumination is somewhat higher when the train is running than when it is at rest. It was found that with metallic-filament lamps the storage batteries could be operated at surprisingly low voltages. These facts make it possible to use an arrangement in which the lamps are connected in parallel with the battery and the dynamo, the voltage of which is adjusted by a special regulator. There are no energy-consuming resistors in series with the lamps and the batteries, no lamp regulators, no iron-wire resistors, relays or other complications. In the present instalment the author describes the results of tests on the charging of storage batteries. The general results are as follows, for batteries in good normal condition: The charging emf should be not more than 2.4 volts per cell, if damage is to be avoided. For a full charge of the battery a charging emf of 2.25 volts per cell is just sufficient. The ratio of the charging ampere-hours to the discharging ampere-hours is always higher than unity if the charging has been continued for a sufficiently long time and charging pressures above 2.25 volts per cell have been used. The battery may be maintained in operation for long periods with relatively low charging voltages without danger of damage. As the initial charging current is rather high, charging of the battery at constant voltage is unsuitable. The charging of the battery should not start with constant voltage, even if only 2.25 volts per cell is used, but the charging voltage at start should be automatically adjusted to a lower value, the more the battery has been discharged, if melting of the fuses and overloading of the generators and the apparatus are to be avoided. The author begins to discuss the method of regulation and the characteristics which the generator must have. The article is to be concluded.—*Elek. Zeit.*, Nov. 26, 1914.

Generation, Transmission and Distribution

Refuse Destructor.—J. FESTNER.—An article on the garbage incinerator in the city of Barmen, Germany, which has 172,000 inhabitants. It was erected in 1907 and has proved quite satisfactory. The garbage is burned to a slag which is later ground into sand used for brick and building purposes. The gases resulting from the burning of the garbage have a temperature from 1200 deg. to 1500 deg. C. and are used for raising steam under boilers in connection with a 400-kw turbo-generator. The electricity is sold at ⅞ cent per kw-hr. to the municipal electric station, which sells it at 2.75 cents. One ton of garbage yields 0.5 ton of slag and 77 kw-hr. of energy. During one year 22,000 tons of garbage is burned, yielding 11,000 tons of sand and 1,700,000 kw-hr. of energy.—*Science*, Dec. 18, 1914.

Traction

Alternating-Current Traction.—A fully illustrated description of the single-phase motor cars used on the Loetschberg mountain railway operated at 15,000 volts. —*Elek. Zeit.*, Nov. 26, 1914.

Installations, Systems and Appliances

Crane Controllers.—H. H. BROUGHTON.—A fully illustrated article on magnet-switch crane controllers. In this article the author describes the construction, operation, arrangement and connections of remote-control systems, and shows how these are applied to heavy cranes. Speed control, dynamic braking and automatic acceleration are dealt with, and a number of typical magnet-switch control systems applied to the several motions of a crane are described.—London *Electrician*, Nov. 27 and Dec. 4, 1914.

Protective Gear.—KENELM EDGCUMBE.—The first part of an illustrated article on over-voltage protective gear for high-tension circuits. In the present instalment protection against disturbances due to external causes is discussed. The article is to be continued.—London *Elec. Review*, Nov. 27, 1914.

Cooking Installation.—An illustrated description of a military electric cooking equipment recently installed by a London central station.—London *Elec. Review*, Nov. 27, 1914.

British Central Station.—A fully illustrated description of the large new extension of the Hackney municipal electric station. The plant was opened thirteen years ago with a direct-current supply, but for the extension a three-phase system at 6000 volts and fifty cycles and distribution from substations has been adopted. The substations feed energy to the existing direct-current network, except in the case of very large consumers, who are supplied with energy directly from the high-tension alternating-current system. For the three-phase generating plant one 3000-kw turbo-alternator has been installed and a 5000-kw set has been ordered Each of the three substations contains two 500-kw Lacour converters.—London *Elec. Review*, Dec. 4, 1914.

Wires, Wiring and Conduits

Testing High-Tension Cables by Direct Current.—An account of the discussion which followed the reading of the paper of Lichtenstein, recently abstracted in the Digest, on the use of the Velon system for testing alternating-current cables by means of high-tension direct current. Apt asked about the size of the testing machine, since a certain minimum of capacity serves to break a cable down. He also asked as to the connections of the cable to the positive or the negative poles of the machine, since there should be a difference in these two cases on account of osmosis. In reply to the later question, Lichtenstein said that no special pains had been taken to investigate the polarity of the connections, so that probably each conductor had been connected as often to the positive pole as to the negative pole. No particular difference had been observed. Rüdenberg and

Bercovitz also participated in the discussion. As to the capacity of the testing plant, Lichtenstein said that the Delon rectifier of the Siemens & Halske company was of 10-kva rating. The power consumption in the test depends primarily on the current passing in continuous operation through the cable insulation. Let it be assumed that the insulation resistance of a fault in course of formation is 12,000,000 ohms. At 150,000 volts there is then a fault current of 0.0125 amp, which is superposed on the normal insulation current. If the testing plant can supply this current without an appreciable drop of voltage, the Joulean heat at the fault is 1875 watts, or 1.875 kw. Under these conditions the fault resistance will soon be reduced to zero, so that it is possible to locate it. The Delon rectifier of the Siemens & Halske company has a sufficient capacity to supply the necessary current without considerable voltage drop.—*Elek. Zeit.*, Nov. 5, 1914.

Cable Laying.—An illustrated description of the methods employed in laying the cables from the Tyssedal Power Plant on the Hardanger Fjords to the carbide factory in Odda. On account of the mountainous character of the country the laying of the cables was rather difficult. Two parallel cables, each of 3×120 sq. mm., for 1250 volts are employed.—*Elek. Zeit.*, Nov. 5, 1914.

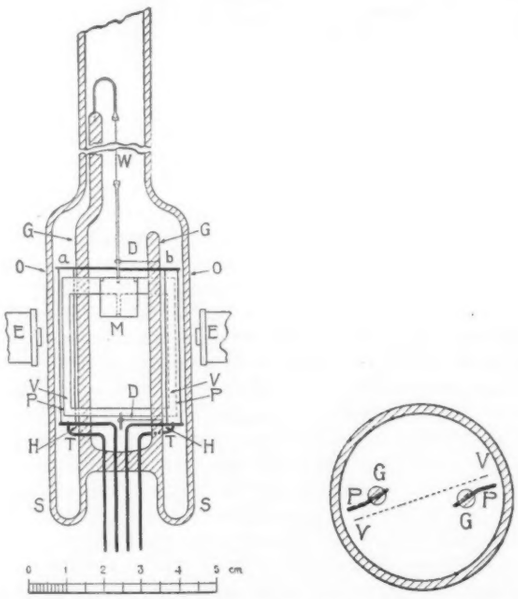
Electrophysics and Magnetism

The Electrical Resistance of Thin Metallic Films and a Theory of the Mechanism of Conduction in Such Films.—W. F. G. SWANN.—The theory which attributes electrical conduction to the presence of free electrons requires, in order that the variation of the resistance of a metal with the temperature T shall be explained, that the mean free path of an electron shall vary as T^{-2}. The original object of the present work was to test this fact by direct experiment. Patterson has shown that the specific resistance of a very thin film is abnormally high, and, moreover, that it increases very rapidly as the thickness diminishes below a certain critical value. Sir J. J. Thomson has shown that a rapid increase of this kind can be explained as due to the fact that when the dimensions of the film get comparable with the mean free path of an electron, those electrons which at any instant are moving in a direction inclined to the plane of the film do not get a chance of traveling for their complete mean free path, so that the electric field does not produce in them the full velocity which it would produce if the true mean free paths were described. From this theory and the T^{-2} law it would follow that when a film is cooled down to liquid-air temperature there should be a distinct displacement of the distance of the bend of the curve from the origin of thickness. It was found that no such displacement of the bend took place, and apart from certain relatively small variations of the resistance of the films with temperature, the curves at the two temperatures were practically coincident, at any rate in the neighborhood of the bend. The experiments are not taken as necessarily proving that the free path does not vary as T^{-2}, but rather as showing that the explanation of the sharp bend is to be found from another standpoint than that which explains it as due to the thickness of the film comparable with the mean free path. The author gives a new theoretical explanation.—*Philos. Mag.*, October, 1914.

The Spectrum from Mercury Vapor in an Electric Field.—C. D. CHILD.—The vapor rising from a mercury arc is luminous and the relative intensity of the different lines in the spectrum of the light can be modified by an electric field. This may be done by changing the potential difference covered by the mean free path of the electrons. The greater this potential difference the more prominent the green line as compared with the yellow ones. This may be explained by assuming that certain lines are produced by the union of electrons with positive ions which lack one electron, while other lines are produced by the combination of electrons with positive ions lacking more than one electron.—*Phys. Rev.*, October, 1914.

Units, Measurements and Instruments

Measuring High Vacuums.—J. W. WOODROW.—A description of a very sensitive Knudsen absolute manometer. The gage is shown in Figs. 1 and 2 and the electrical circuits in Fig. 3. The glass rods *GG* serve as supports for the metallic parts of the gage. All the internal electrical connections and adjustments, with the exception of the final leveling, are made before the outer glass wall *OO* is sealed on at *SS*. The suspension *W* is a phosphor-bronze ribbon. The movable van *VV* consists of a rectangular frame of aluminum. The heating plates *PP* are platinum strips. The deflections of the movable vane are obtained in the usual way by the reflection of a beam of light from the mirror *M*. The phosphor-bronze suspension is connected at both



FIGS. 1 AND 2—DESIGN OF MANOMETER FOR MEASURING HIGH VACUUMS

ends by threading through three small holes drilled into the flattened extremities of the platinum and aluminum wires respectively. The small loops *DD* are so placed that they support the movable vane *V* except when the gage is leveled for taking readings. This makes the gage readily portable. The moving system is electrically connected through the suspension to that terminal of the heating strips which was grounded, the whole being screened from external electrical disturbances by an earthed silver coating on the outside of the glass walls. A small electromagnet, shown at *E* in Fig. 1, is employed in bringing the moving vane to rest. The temperature of the heating strips is determined by the method shown in Fig. 3. The potentiometer leads *TT* are electrically welded to the very extremities of the platinum heating vanes *PP*. The heating current is regulated by the resistor of variable resistance ρ and its value is read on the ammeter *A*. The resistance r_2 is kept constant at 10,000 ohms and r_1 varied to obtain a balance of the sensitive galvanometer *G*. The potentiometer battery *C* consists of a carefully calibrated Weston standard cell. This arrangement gives an accurate method of measuring the resistance of the

platinum strips *PP*, plus the heavy platinum wire *ab*. According to the theory of Knudsen, the gas pressure within the gage is $P = \frac{2K}{\sqrt{T_1/T_2} - 1}$, where K is the uniform pressure in dynes on each square centimeter of the movable vane and T_1 and T_2 are the absolute temperatures of the heating strips and of the moving vane respectively. If the difference in temperature is small as compared to the absolute temperature, the formula may be written $P = 4K\frac{T_2}{T_1 - T_2}$. This formula is independent of the nature of the gas or vapor to be measured. For the dimensions of the author's instrument the formula becomes $P = 2.2 \times 10^{-3} \frac{T_2}{T_1 - T_2} d$ mm of Hg, where d is the deflection in milimeters on a scale at a distance of 1 m from the mirror. As it is easily possible to obtain a temperature difference of 100 deg. C., and since a deflection of 0.5 mm can be observed, the gage will measure a pressure as low as 3×10^{-5} mm of Hg. Radiation pressure has no appreciable effect. Some notes are added to the article which deal with the production of very low vacuums.—*Physical Review*, December, 1914.

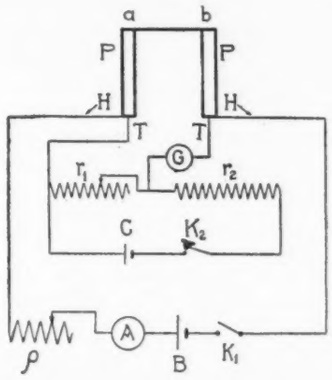


FIG. 3—WIRING CONNECTIONS OF MANOMETER

Ohmmeter with Several Scales.—H. A. W. KLINEHAMER.—While many firms build ohmmeters, their use is not very extended, probably because they are mostly designed for one single scale. The simplest ohmmeter consists of an ammeter in series with the resistance to be measured and a source of constant emf. The ammeter may then be empirically calibrated in ohms. The author discusses the problem how it is possible to design an ohmmeter so that by a simple turn of a switch the scale divisions represent 10 or 100 times greater values. If the relation between the unknown resistance x and the current i is given by the equation $x = cf(i)$, the problem is that, by simply operating a switch, c be changed from 1 to 10 or 100, etc. The author discusses the very general case of a network with constant electromotive forces containing in different branches the ammeter, the battery and the resistance x to be measured, and shows that if the deflections a of the ammeter are proportional to the current through the ammeter, then the general relation holds true that $x = W\frac{a_o - a}{a - a_{oo}}$, where x is the resistance to be measured, W the total resistance of the network without the resistance x, and a the deflection of the ammeter when the resistance x is inserted. a_o is the deflection of the ammeter for the resistance $x = 0$ and a_{oo} the deflection of the ammeter when the resistance x is infinitely large. Evidently a_o and a_{oo} are the end marks of the scale. According to the above formula the unknown resistance x is found when the ratio of the distances of the position of the ammeter needle from the two end marks of the scale is multiplied by the total resistance W of the whole network. This result is independent of the special arrangement of the connections. It follows that the scales of all ohmmeters must be similar, whatever their connections. They differ only in the position of the end marks and in the value of the constant W. If the end marks are fixed (that is, if i_o and i_{oo} are maintained constant), a change of the total resistance W of the network will change the constant of the proportionality. Many solutions are possible, but not all are equally good in practice. The problem is greatly simplified if the resistance to be measured is connected either in series or in parallel with the battery and ammeter. For the series connection $i_{oo} = 0$, where the problem is to find an arrangement by which the total resistance of the network can be changed without changing i_o, the simplest arrangement is the Wheatstone bridge as shown in Fig. 4. The ammeter in series with the resistance x to be measured is in one side branch of the bridge. The bridge is so adjusted that with the resistance x short-circuited there is equilibrium. This equilibrium will not be disturbed and the current i_o in the ammeter will not be changed (as long as resistance x is short-circuited) if the resistance of the diagonal branch of the bridge is varied by the movement of a switch as indicated in the diagram. But the total resistance of the network may be greatly changed thereby. In this way it is possible to let the constant W assume the values of 10, 100, etc., the arrangement being very suitable for an ohmmeter.—*Elek. Zeit.*, Nov. 26, 1914.

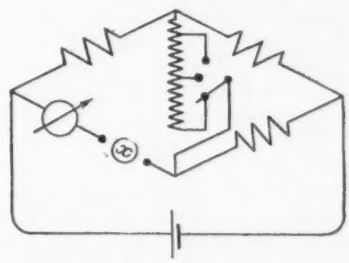


FIG. 4—ARRANGEMENT OF WHEATSTONE BRIDGE

Telegraphy, Telephony and Signals

Quenched-Spark Transmitter.—EMIL J. SIMON AND LESTER L. ISRAEL.—A paper read before the Institute of Radio Engineers on the operating characteristics of a three-phase, 500-cycle quenched-spark transmitter. The attempt to produce a nearly continuous radiation of energy and high-tone frequencies by the use of polyphase transmitters is historically considered. The work of Eisenstein and Seibt is described. Experiments were made with two-phase and three-phase transmitters. It was found that the wave trains produced by successive discharges in adjacent phases overlapped in the antenna, thereby causing unmusical tones in the receiver and a diminution of transmitter efficiency. This decrease in efficiency is attributable to the increased reaction of the antenna on the closed oscillating circuits and the consequent disturbance of the regularly spaced spark discharges of the transmitter of each phase. By increasing the antenna damping, thereby lessening the overlapping of successive wave trains, the musical quality of the tone was improved and the transmitter efficiency markedly increased. Tests on dummy antennas and actual long-distance tests were made. The production of practically sustained radiation, susceptible of reception by the use of the ticker or analogous devices,

and produced by polyphase transmitters, is favorably considered. The limitation of quenched transmitter efficiency by the overlapping of rapidly successive wave trains is discussed.—*Proceedings*, Institute of Radio Engineers, September, 1914.

Miscellaneous

Swiss Exhibition.—Ernst Winkler-Buscher.—The conclusion of his report on the Swiss exhibition in Bern. The author gives an account of exhibits of various Swiss manufacturers in the Machine and Apparatus Building and then describes the Transportation Building and the Hydroelectric Building. An indication of the size of the exhibition is the fact that on a weekday there were 43,000 visitors without any crowding being noticed.—*Elek. Zeit.*, Nov. 5, 1914.

British Electrical Engineers and the War.—Thomas Roles.—His address, as chairman, to the Yorkshire Section of the (British) Institution of Electrical Engineers. He first discusses the conditions under which electrical engineers should go to the front. He emphasizes that many members, to do their duty, must perforce remain to control and run their undertakings, however martial may be their spirits. "Those who are actually engaged on work required for military purposes should at this crisis remember that much, very much, may depend on the work of the humblest worker, and that time is the essence of the contract just now." He then takes up the question how employers should handle the situation, and suggests that those of the members who have not up to the present arranged to do so should set aside regularly during the period of the war, and as long as necessary after, a definite percentage of their incomes weekly or monthly for the benefit of relief funds formed to assist persons affected by the war. The motto, "Business as usual during the war," is a good one, but one that can be acted upon only to a limited extent. He refers to the capture and retention of foreign and colonial trade from Germany and Austria, and emphasizes "the tremendous extent to which the British industry has relied on foreigners for the design and supply of electrical and even mechanical apparatus." To change matters he suggests that methods of technical education in Great Britain should be changed. "Better results might be obtained if the higher branches of electrical and mechanical engineering were taught at a few extremely well-equipped centers in this country by well-paid professors having the very highest technical qualifications, instead of each town of any size endeavoring to provide such facilities at technical schools."—London *Electrician*, Nov. 13, 1914.

British Technical Education.—Robert W. Paul.—The author thinks that the average British electrical student who applies for employment in the factory has been trained neither to work strenuously nor to think and plan clearly. His ideas of first principles and practical requirements are hazy. "If the teaching authorities fail to appreciate the fact that narrow but thorough vocational training must be the basis for the future culture of the majority of lads, the manufacturers, singly or jointly, will be forced (in fact, are being forced) to provide trade education in connection with their factories." The author thinks that the British manufacturers are not to be blamed. His point is that the present electrical training in Great Britain is not the best adapted to develop British trade nor does it satisfy the needs of the manufacturers.—London *Electrician*, Nov. 13, 1914.

Electrical Exports from Germany.—An article giving a statistical table and a diagram of the exports of electrical products from Germany to other European countries from 1909 to 1913.—*Elek. Zeit.*, Nov. 12, 1914.

Book Reviews

Installations Electriques de Force et Lumière. By Adr. Curchod. Paris: H. Dunod and E. Pinat. 222 pages, 80 illus. Price, 7.5 francs.

This book contains a useful collection of connection diagrams in direct-current and alternating-current engineering. There are forty diagrams relating to direct-current systems, twenty-three relating to alternating-current systems, and seventeen to miscellaneous systems. From a practical standpoint the book might be improved if opposite to each diagram were printed the explanatory text pertaining to it. As the volume is arranged the explanatory text is collected by itself in the first section of forty-five pages, and then come the plates by themselves, occupying eighty double pages, each being alternately a blank and a diagram. Consequently the reader has to oscillate between a diagram and its text. The diagrams are well executed, detailed and carefully worked out. The book will recommend itself to electrical engineers and students of circuits generally, especially those interested in European practice.

Cours d'Electricité Théorique. Vol. I. By J. B. Pomey. Paris: Gauthier-Villars et Cie. 396 pages, 90 illus. Price, 13 francs.

This is an interesting volume on the theory of electricity and magnetism, drawn up in the form of a college textbook by an engineer. It is seldom that an engineer devotes himself to the mathematical theory of electromagnetics on what might be called the purely theoretical and mathematical side. He more frequently devotes himself to the side of applications. The book is divided into nine chapters, relating to the following respective subjects: Electrostatics, electrokinetics, magnetism, elements of vector algebra, electrodynamics, theory of induction, general equations of the electromagnetic field, the theory of Lorentz, the propagation of electromagnetic waves. Despite the strictly theoretical character of the work, which resembles that of Mascart and Joubert, the treatment leans somewhat toward the concrete, as, for instance, in the orientation of coordinates eastward, southward and upward. Several problems of a concrete character are also discussed. The book will recommend itself to students of electromagnetic theory interested in the presentation of this wonderful subject by French scholars.

La Téléphonie et les Autres Moyens d'Intercommunication dans l'Industrie des Mines et des Chemins de Fer. By P. Maurer. Paris: H. Dunod & E. Pinat. 232 pages, 115 illus. Price, 9 francs.

A good practical treatise on electric signaling, with particular reference to wire telephony in industrial, mining and railroad service. It is addressed to those who are interested in the installation or maintenance of such systems, and especially to those who have some knowledge of electric mechanisms but are not engineers. The chapters deal with the following subjects: Electric generators; acoustic signals; optical signals; telephony; automatic telephony; transmitters; indicators; mine signals; telephony and telegraphy; railway telegraphs; aerial lines; subterranean lines, installations, faults and tests; telephone systems; intercommunicating systems. The book is well illustrated, and the various systems of apparatus are explained in simple terms with no mathematics beyond arithmetic. The volume will interest those who desire to become informed concerning the elements of electric signaling, especially in Europe.

POWER AND OPERATING SECTION

Flower Bed to Beautify Station Interior

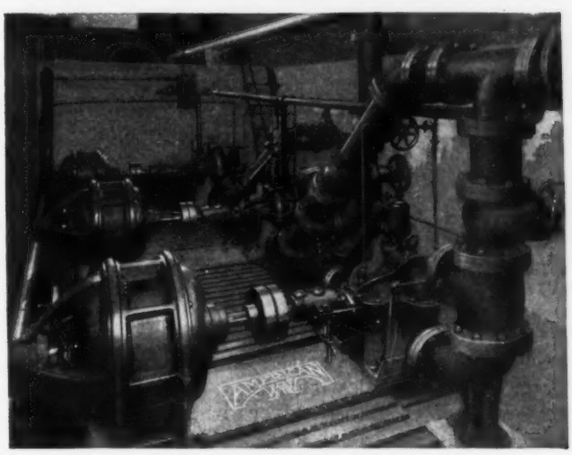
When a new electric-lighting station was erected at Downs, Kan., a portion of the power-house floor, later to be occupied by an additional prime mover, was left unfinished. In that condition it presented an unsightly appearance compared with the clean concrete floor in all other parts of the engine room. As a temporary and inexpensive means of hiding the ugly hole the engineers have planted a flower garden on the spot where a future engine unit will stand.

Electric Pumping Plant

A motor-driven pumping installation presenting several interesting features has recently been installed by the Chicago & Eastern Illinois Railroad at Villa Grove, Ill. The equipment is designed to supply water for passenger and freight trains, locomotives and the railroad roundhouses and shops at this place. The plant consists of three 5-in. double-suction, split-shell, inclosed-impeller, motor-driven, centrifugal pumps, made by the American Well Works, Aurora, Ill. The installation is in a pit extending 6 ft. below the station floor level. Water is taken from the Embarras River, which is about 100 ft. distant. The pump shown at the far end of the accompanying illustration takes water from the river and delivers it at the rate of 500 gal. per minute against a total head of 21 ft. into a surface reservoir and settling basin of several acres area, near the pumping station. The discharge pipe from this pump passes through a side wall of the pit and is submerged in the reservoir.

The other two pumping units are duplicates and are automatically controlled by pressure governors. These pumps operate separately, and deliver water from the reservoirs to a 100,000-gal. elevated tank situated 1200 ft. distant, near the railroad shops. A pump starts when the tank is half emptied and delivers an average of 750 gal. per minute until the tank is full. The pump then stops and remains inactive until the tank is again half emptied.

The low-head pump operates continuously for several

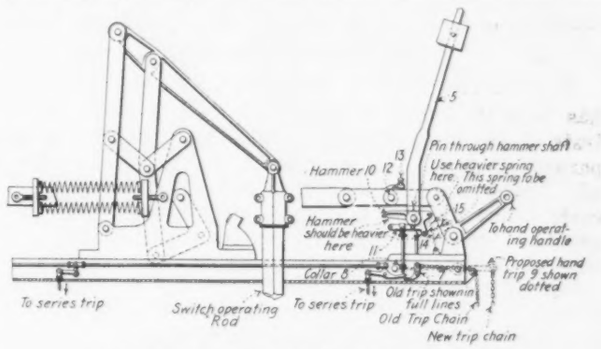


ELECTRIC PUMPS AT VILLA GROVE, ILL.

days, or until the reservoir is filled. The pipe is so arranged that the low-head pump can deliver from the river to the reservoir while the other pumps are either idle or delivering to the tank, singly or in parallel, one automatically and one manually controlled. The middle pumping unit is designed to deliver from the river to the reservoir, from the river to the tank, or from the river to an auxiliary reservoir, through the long pipe shown at the top of the illustration. The motors are designed for three-phase, sixty-cycle, 440-volt operation. The low-head motor is rated at 5 hp and operates at 570 r.p.m., while each of the others is rated at 25 hp and operates at 1740 r.p.m.

Improved Tripping Mechanism for Oil Switch

The tripping mechanism of a certain well-known type of oil switch proved unreliable when installed in isolated stations of the Washington Water Power Company, of Spokane, especially in cases where the mechanism had



TRIPPING MECHANISM OF OIL SWITCH

not operated for months after it had been adjusted in localities where there is considerable range of temperature, or dust in the air, or when the weather is damp and foggy.

The operating factor was too low to overcome the effects caused by these elements on the mechanism, which tended to corrode, rust and bind it.

In the original arrangement, a spring 14 operated a hammer 10 to break the main toggle 12 and permit the switch to open. When the center joint of the main toggle was set far enough below the center line of its end bearings to permit the closing of the switch, however, it was supposed that it could still be tripped by the blow of the hammer 10 acting under the force of the spring 14, but after the switch had been set for weeks or months under severe weather conditions it was found impossible to knock the switch out with this hammer blow.

On increasing the strength of the spring 14 to strengthen this hammer blow, greater force was put on the small toggle 11 and trouble was experienced in holding or breaking this toggle with the force of series relays. Recourse was then had to an arm and adjustable weight 5, this arm being pinned solid with the hammer 10 to a shaft.

It will be seen that in the closed position of the switch, the force holding the small toggle 11 is very slight, allowing it to be broken easily, thus permitting the arm and weight 5 to drop to the right, and strike toggle 12 with hammer 10 a blow of great force.

On experimenting with the redesigned mechanism it was found that the small toggle 11 could be broken with considerably less force than in the old arrangement. The large toggle 12 can also be easily broken when set ¼ in. below the center line of its end bearings, with the main torsion springs set up to the limit. Nearly all the switches of the Washington Water Power Company have been equipped with this device for over one year, and there have been no failures with it.

Fans Employed to Extinguish Fire in Underground Conduit

Ventilating fans were employed recently at Cleveland, Ohio, to force a fire-extinguishing compound through underground ducts containing burning cables. Exhaust fans were installed at the opposite end of the duct run to remove the highly inflammable gases which were produced by the volatilization of the rubber and paraffin insulation. It was not until after the cables had burned several hours, however, that this novel use of electric fans could be made, as the burning gases issuing from the conduits prevented men entering the manholes. While the underground cables were being replaced emergency service was furnished through temporarily installed aerial conductors.

Rack and Switchboard for Life Tests on Series Incandescent Lamp

The Electric Testing Laboratories, New York City, has recently installed equipment for conducting life tests on any type of series incandescent lamp. The apparatus consists of three racks supporting six electrically distinct circuits of 192 sockets and a bench-type switchboard for feeding each circuit separately and simultaneously or in any combination. Each rack consists of vertical iron pipes supporting eight offset horizontal rails made of asbestos board. On the lower side of each rail are fastened eight series-type sockets which will accommodate any incandescent lamp now made. On the upper side of the rails above each socket and connected to the terminals thereof are spring lips. Between the lips can be inserted film cut-outs which short-circuit the lamp sockets when a lamp is removed or

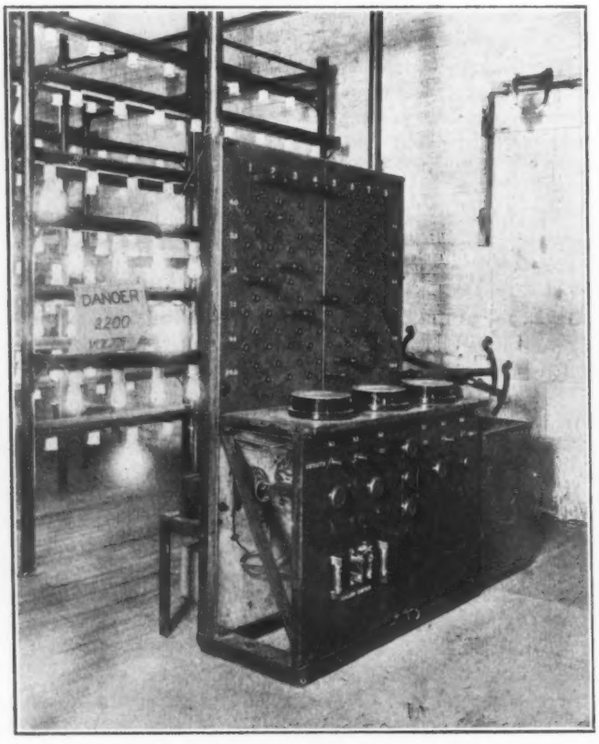


FIG. 1—APPARATUS FOR CONDUCTING LIFE TESTS ON SERIES INCANDESCENT LAMPS

burned out. The lips are connected in series by brass strips fastened to the asbestos board. A fiber duct from which a longitudinal strip has been removed is employed to cover the upper side of each rail, thereby preventing accidental contact with the lips and connectors. Wires feeding each group of sockets are conveyed to the rails through the metal uprights and thence through asbestos blocks to the end sockets. It is planned to increase the total number of sockets supported on the racks to 328 by installing additional rails between those

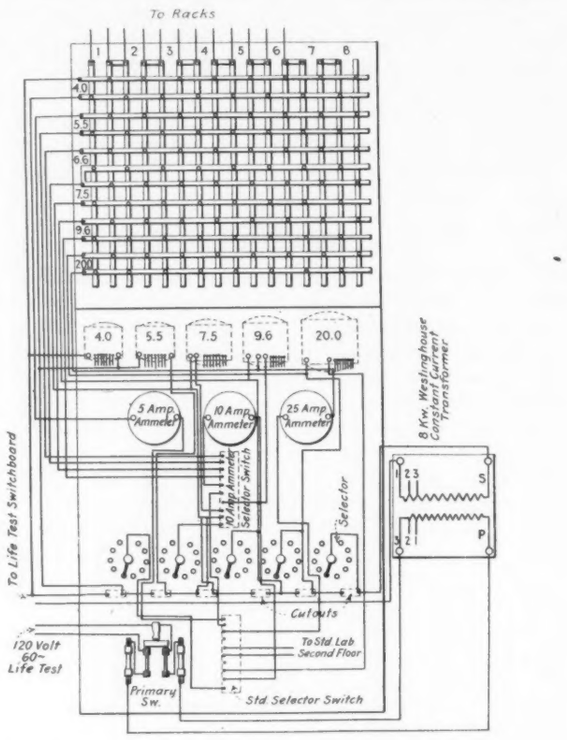


FIG. 2—DIAGRAM OF RACK AND SWITCHBOARD

now used, but offset so as not to interfere with the lamp bulbs.

Any single rack or group of circuits can be supplied with constant-value current of 4, 5.5, 6.6, 7.5, 9.6 or 20 amp by inserting plugs in receptacles on the front of the upper panels of the control board. The current in each circuit can be varied by turning switch handles on the lower panels and can be measured by ammeters on the horizontal part of the switchboard. The wiring connections on the control board are indicated in the diagram shown herewith. The terminals of each rack circuit are connected with the vertical busbars. Crossing these bars but insulated therefrom are six pairs of constant-current busbars in which the values of current given above can be maintained. On the front of the panels opposite the points where the busbars cross are receptacles for screw-tip, arc-circuit-type plugs which are used to connect the rack circuits in series with the desired feeding busbars. For instance, if it is necessary to supply 4 amp to rack No. 1 plugs are inserted in the holes over the intersection of the 4-amp and No. 1 rack busbars. If several racks are to be supplied with the same current, they are connected in series by inserting plugs in the upper holes marked with the rack numbers and also in the receptacles over the intersection of the terminal and feeding busbars.

The horizontal busbars are connected as shown to five auto transformers joined in series with the secondary of a single constant-current transformer. The auto transformers are rated at 4, 5.5, 7.5, 9.6 and 20 amp, the 7.5-amp unit being designed to feed the 6.6-amp and 7.5-amp busbars and the 9.6-amp unit either 9.6-amp or 10-amp circuits. A variation of 2 or 3 per cent can be made in the value of the currents supplied to each circuit by means of switches which connect the busbars

to different taps on the auto-transformers. The ammeters are rated at 7.5, 10 and 25 amp, the first being employed on the 4-amp circuits, the second on 5.5, 6.6 and 7.5-amp circuits, and the third on 20-amp circuits. Switches operated from the front of the board permit connecting these meters in the circuits without breaking the continuity thereof. Another selector switch allows the connection of any one of the ammeters in series with a standard instrument for the purpose of checking readings during operation. Cut-out plugs operated from the lower panels permit short-circuiting the auto-transformers when they are not in service, thereby eliminating their iron and copper losses.

Explosive Gases Generated in Transformer

Recently a large transformer in South Africa broke down, and a chief electrician with three assistants started to disconnect the defective transformer and empty out the oil preparatory to lifting the core out of the case. It was considered necessary first to empty the expansion tank above the transformer, and although a gage glass showed the level of the liquid in the tank, one of the men held a lighted match over a pipe hole to discover the contents. A severe explosion occurred and all were killed or badly burned. The tank was burst, and the oil scattered in all directions, setting fire to everything inflammable in the transformer chamber. The oil in the tank is not hotter than about 34 deg. C., and as its flashing point had been proved to be about 140 deg. C., the explosive gas could not have been mere oil vapor. Experiments were conducted with extra high-tension discharge on the transformer oil, and a sample of the resulting gas was collected. On analysis, this proved to contain at least 62 per cent hydrogen, showing that transformer oil tanks, and in fact all tanks used for oil switches, etc., should be considered as possibly containing explosive gas. If the transformer and switch tanks are unventilated, it would be prudent in view of the above accident not to approach either with a naked flame.

Cable-Laying Plow

A considerable part of the money invested in underground distribution systems has usually been expended in installing the cable. To reduce the expense of laying

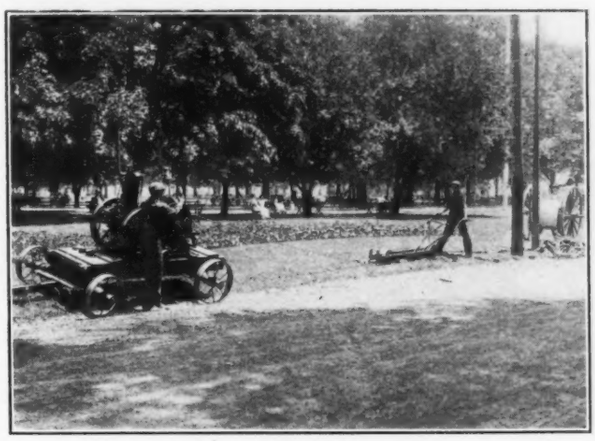


FIG. 1—PLOW LAYING CABLE

cable in the bare earth the construction department of the Philadelphia (Pa.) Electric Company has developed a special plow for cutting a deep groove in the ground and drawing in the cable at the same time. Fig. 1 shows the plow being pulled by a portable gasoline-engine-driven drum and drawing in a cable from a reel supported on large-diameter wheels. A closer view of the plow is given in Fig. 2. The frame of the plow consists of two channels fastened back to back but several inches apart. Between them at each end is a wide-faced roller for supporting the plow on the surface of the earth. Just back

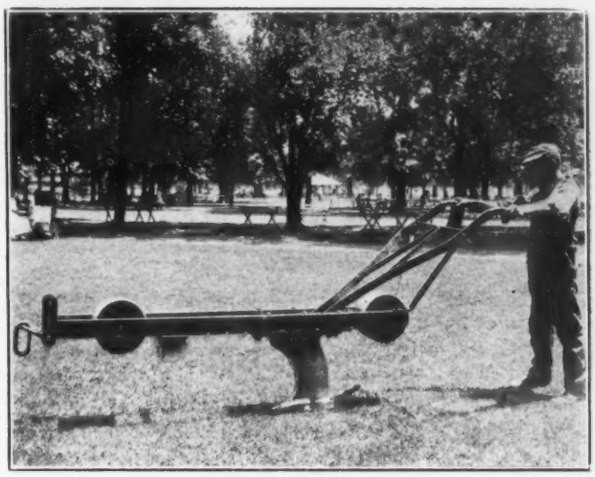


FIG. 2—VIEW OF PLOW

of the front roller and attached to the under side of the channels is a knife-edged steel roller disk for cutting the sod in front of the plowshare. Fastened to the channels in front of the rear roller is the plowshare or knife-edged plate. The plate is shaped so that it merely cuts a groove and does not throw out any earth. After the cable is installed it is only necessary to tamp the top of the groove. The cable being drawn into a groove is fastened to an eye in the rear lower corner of the plowshare. This machine has been used for a number of installations and has proved very satisfactory in cutting down the labor and time of completing a job.

Large Water Rheostats

For making an overload test on a 13,200-volt, 3000-kw steam turbine set the engineers of the Washington

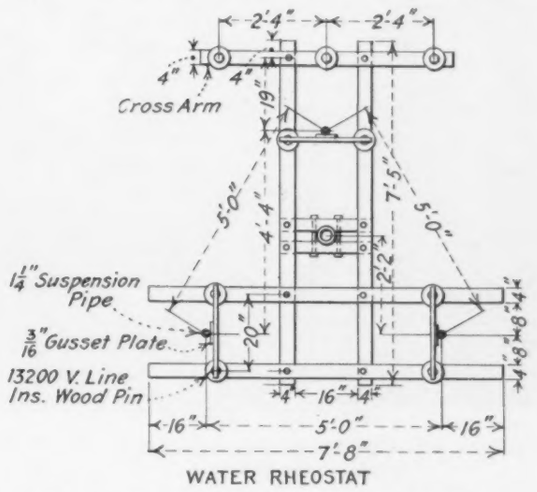


FIG. 1—ARRANGEMENT OF WATER RHEOSTAT

Water Power Company employed an iron-pipe rheostat in the Spokane River alongside of its steam station. Three 6-in. pipes, 4 ft. long, placed in a triangle were suspended on insulators from a framework arranged to be raised and lowered along a fixed guide by means of

a cable fastened to a hand winch. This arrangement dissipated 2600 kw when immersed 42 in., as shown by Fig. 1. The temperature of the water in the river at the time was about 55 deg. Fahr. To increase the carrying capacity of the rheostat, 8-in. pipes, 4 ft. long, were slipped over the 6-in. pipes and when this rheostat was fully immersed almost 6000 kw was carried

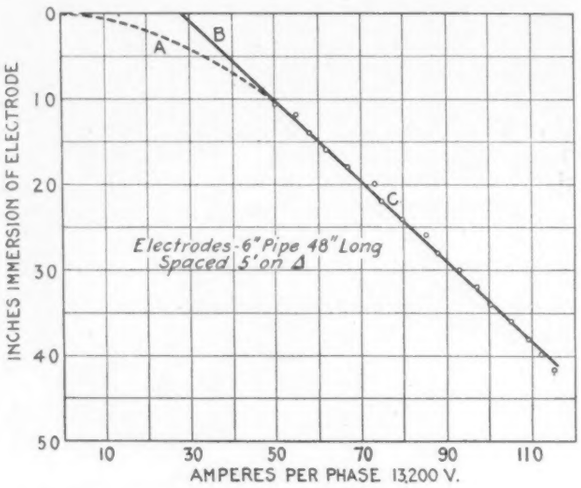
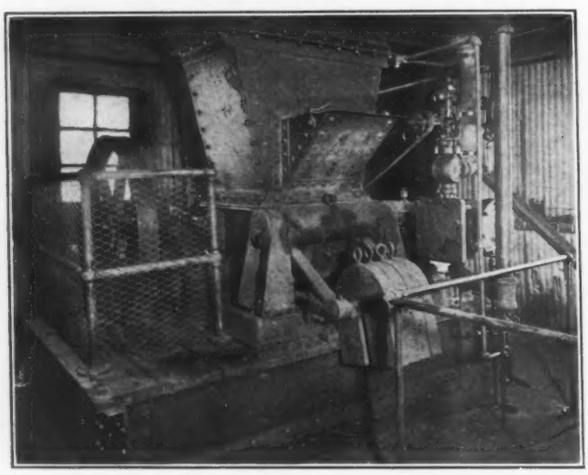


FIG. 2—TEST OF WATER RHEOSTAT AT SPOKANE

in a very steady manner with a separation of 40 in. The location chosen in the river was opposite the discharge tunnel for the circulating water used in the condenser. The addition of this warm water raised the natural river temperature at this spot to 55 deg. Fahr.

Belt-Drive Preferable for Coal Crushers

A number of central-station operators consider it more economical to drive station auxiliaries by steam, as the exhaust therefrom may be employed in heating boiler-feed water or in driving low-pressure turbines. In operating coal crushers, however, the Edison Electric



COAL CRUSHER CONVERTED FROM STEAM-ENGINE DRIVE TO MOTOR DRIVE

Illuminating Company of Brooklyn, N. Y., has found it better to sacrifice the plant efficiency obtained by using steam engines and use motor drive with belt transmission, as any obstruction in the crusher will either throw off the belt or open the motor circuit-breaker instead of breaking parts of the machinery as when reciprocating steam engines are used. The accompanying illustration shows a coal crusher which this company has converted from direct steam drive to motor belt drive. This change became necessary as car couplings and pieces of steel frequently passed into the crusher along with the coal, stopping the rolls and reciprocating engine almost instantly and subjecting the parts to excessive stresses. With the present equipment the crusher or motor cannot be subjected to very great stresses as sufficient slack is left in the belt to allow it to slip in case the crusher becomes clogged.

Manhole Equipment for Pulling Cables

When constructing manholes it is advisable to provide facilities for drawing cables through ducts so that special guide supports do not have to be used. The ac-

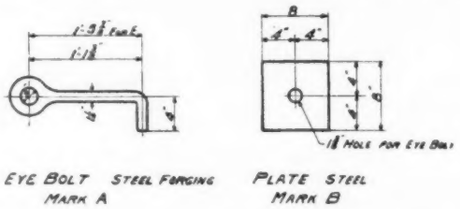


FIG. 1—DETAILS OF EYE-BOLT AND BEARING PLATE

companying illustration shows how the manholes in the underground distribution system of the Pittsburgh Crucible Steel Company's plant at Midvale, Pa., are equipped for this purpose. In the wall opposite and about 12 in. below each duct entrance is an eye-bolt which extends through the wall and is bent over on the end to bear on an iron plate which reduces the unit

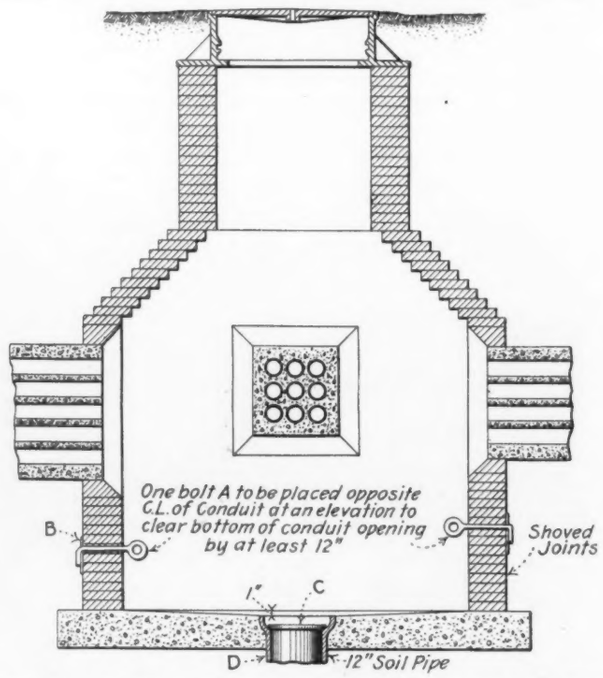


FIG. 2—DIAGRAM SHOWING EQUIPMENT OF MANHOLE TO FACILITATE CABLE LAYING

pressure on the manhole wall. This eye-bolt may be employed to support a guide block during the usual installation of cable or it may be connected to a block and tackle when it is necessary to draw a cable into place for splicing in cases where sufficient length has not been left for this operation.

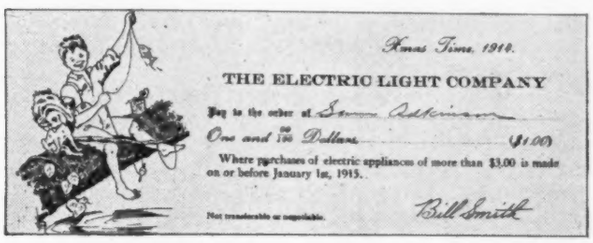
COMMERCIAL SECTION

Electric Christmas-Tree Lanes at Ottumwa, Ia.

The holiday decorations installed by the merchants of Ottumwa, Ia., took a new form this year. Evergreen trees were installed throughout the business district, and on the branches of these trees miniature incandescent electric lamps were mounted to be lighted during the evening hours. By sprinkling the trees with water during freezing weather icicles were formed which added to the holiday aspect of these unusual decorations. Coincidentally with the display, the local electrical supply dealers and the Ottumwa Railway & Light Company co-operated in an electrical exposition to stimulate the sale of household devices.

A Christmas Check from the Electric Light Company

The several thousand customers of the Light & Development Company, of St. Louis, in more than twenty Middle Western cities received a non-negotiable check for $1 as a Christmas gift from "Bill Smith." In every-


Xmas Time, 1914.
THE ELECTRIC LIGHT COMPANY
Pay to the order of
One and 00/100 Dollars
$1.00
Where purchases of electric appliances of more than $3.00 is made on or before January 1st, 1915.
Not transferable or negotiable.
Bill Smith

A CHECK GOOD AT THE STORE OF THE ELECTRIC-LIGHT COMPANY

day life Bill Smith is Mr. W. A. Smith, vice-president of the Light & Development Company, but to the company's patrons who read its human-interest advertising he is just "Bill Smith." With each check there came a letter, one paragraph of which suggested that any one of several electric appliances named would be an acceptable Christmas gift. The letter stated that the inclosed check was a Christmas token and closed by wishing the customer a merry Christmas and a happy, prosperous New Year.

Building Contractor Favors Electric Hoists Over Steam

Mr. D. P. Duncan, construction engineer for the L. W. Dumas Construction Company, Columbia, Mo., used electric motor-driven equipment wherever power applications were practicable in building a ten-story office structure at Springfield, Mo. A 0.5-yd. concrete mixer driven by a 10-hp motor, a concrete hoist driven by a 22-hp motor, a double-platform hoist driven by an 8-hp motor and a general-utility saw driven by a 5-hp motor were chief among the labor-saving and time-saving electrically operated machines. Electricity for the motor was taken from the 220-volt, sixty-cycle, three-phase mains of the Springfield Gas & Electric Company.

The average cost of operating these motors was only about $1 a day. In summing up his reasons for adopting electric drive, Mr. Duncan says that electricity is cheaper than steam, it is more convenient, and no time is lost in "firing up" in the mornings, reasons which are convincing to him.

The "Electric" as a Man's Car

No factor has so interfered with the rightful development of the electric vehicle as the impression which has become general that it is a woman's car, said Mr. D. E. Whipple, Anderson Electric Car Company, Chicago, in a recent talk before the Chicago Section of the Electric Vehicle Association of America. For the business and professional man's use no car is so convenient and practical as the electric, but regrettably the tendency of many manufacturers and salesmen has been to encourage the idea that the battery-driven vehicle is distinctly a woman's equipage. To offset this impression Mr. Whipple urged a campaign of advertising designed to establish the status of the "electric" as the car for the business man and for the whole family. If the emphasis can be laid on the utility of the vehicle for the man's use primarily, a much wider usefulness of the car will result.

Sales Arguments for Electrically Heated Japanning Ovens

Before the convention of the committee on new-business co-operation of the Ohio Electric Light Association, Cincinnati, lately, Mr. Dexter Rollins, of the Simplex Electric Heating Company, presented instructive data for central-station men to use in discussing industrial electric heating with prospective customers. Referring particularly to japanning ovens as a desirable class of business, Mr. Rollins said:

"The prospective customer wants accurate data on first cost and maintenance. High first cost is not generally a serious obstacle, but operation and maintenance charges need careful consideration. Ten cents expended for the several common fuels will produce more pound-Fahrenheit heat units than the same amount expended for electricity. The electrical heat, however, can be used more efficiently.

"Suppose a customer complains of having trouble with gas ovens used for lacquering metal. He says he can't get uniform heat. The quality of the work produced is poor, making it necessary to rebake from 15 per cent to 50 per cent of his product. This customer can be promised a number of things if he takes electric service. Guarantee to increase the production, to raise the quality and increase the uniformity of his product, to better the working conditions of his plant and to save him dollars at the end of the year. He is willing to be shown, he informs you, but thinks that the cost will be prohibitive. Upon examination the customer is found to be operating a metal oven, probably with very poor insulation, heated by an open gas flame working at less than 40 per cent efficiency and using the other 60 per cent to heat the surrounding air, the workmen, and everything, in fact, but the japan on his metal product. To save a portion of the first cost electric heaters may be installed in his present ovens, but that method is not consistent with an attempt to save him money by increased efficiency. Recommend new ovens.

"Assume that it is desired to bake japan on 800 lb. of metal, and that the truck holding this material is also of metal and weighs 200 lb. In the customer's present ovens there is a weight merely in the oven itself of 2000 lb., or 3000 lb. of metal altogether. All this metal must be heated, with the walls of the ovens radiating and conducting heat uselessly, to the outside. In this case recommend an oven constructed of insulating brick, plastered on the outside. If the truck runs on a

track, the inside need not be lined with sheet steel, for the latter is costly to heat and the metal in the product is of sufficient weight for heat-storage purposes. An oven of this construction, with 4-in. walls, will have a heat conductivity of not more than four heat units per square foot per degree difference in temperature per twenty-four hours. In the case of the customer's old metal oven, however, most of the heat is radiated through the walls. The cost of building such an oven will average $50 per 1000 for 4-in. brick, $1.50 to $3 per kw for heaters, and the labor of installing. An existing installation of nine ovens, 8 ft. by 8 ft. by 3 ft., cost only $3,000, including elaborate control apparatus.

"With the ovens constructed as suggested, 25 kw is sufficient to bring the temperature to 400 deg. Fahr. in one hour, and, allowing for differences in ventilating, from 5 kw to 7 kw will maintain this temperature. Computed on a kilowatt-hour basis the cost of this service will probably amount to more than the gas bill, but compared with gas the electric way has many more convincing points to offer. In the ovens an even heat, varying not more than 10 deg., can be maintained. It will be possible to turn out more bakes in a specified time, and at least 98 per cent of the product turned out of the new ovens will be of a high-quality finish, whereas only 60 per cent would be of this quality by the old method and the rest would have to be baked a second time. An absolute case is recalled in which the production was increased in quantity 20 per cent in the same period of operation, while the quality of finish was of much higher grade. Another feature favoring electricity is the ease of control. There are standard panelboards on the market, built especially for this work. They are equipped with pyrometers, contactors and relays, which all go toward making a complete installation and a satisfied customer."

Electric Lighting of Studio Entrance

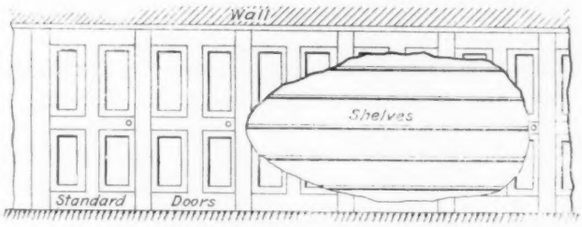
A fine example of the adaptability of electric lighting to artistic service is shown in the accompanying illustration take at the front of the Louis Fabian Bachrach photographic studio in Worcester, Mass. The entrance of the studio is beneath a pergola flanked by two Colonial photograph display cabinets, each of which is

STUDIO ENTRANCE LIGHTED ELECTRICALLY

4 ft. 8 in. high, 33 in. wide and 13 in. deep. Two ornamental columns at the ends carry 60-watt tungsten lamps, 6 ft. 6 in. above the ground, in translucent globes 12 in. in diameter. Each cabinet is illuminated by two 25-watt tubular lamps mounted in a concealed Frink horizontal reflector at the top of the cabinet. The back and bottom of each cabinet are finished in green, the sides being painted white. The cabinets and standards are controlled by a key switch mounted in the rear of one of the former, and energy is supplied through a 110-volt circuit run in ¾-in. underground pipe conduit from the station side of the studio meter through the yard to the cases. Service is furnished at a flat rate of approximately $4 per month by the Worcester Electric Light Company, which provides a patrolman who switches the display into operation at dusk and cuts it out of service at 11 p. m. daily.

Inclosed Shelves Keep Brass from Discoloring

Many electrical contractors save money by buying dissembled fixtures and assembling the parts in their own shops. Sometimes the brassware of these fixtures be-



DARK SHELVES FOR BRASSWARE

comes discolored because it is exposed to the sunlight. Mr. J. T. Coon, manager of the Electrical Equipment Company, Springfield, Mo., avoids the expense of cleaning tarnished brass by keeping all brassware on shelves fitted with swinging doors. The shelves are built against the wall and standard 2-ft. 8-in. by 6-ft. 8-in. white-pine paneled doors attached to vertical jambs are used to shut out the light. All doors swing in the same direction.

Public's Demand Is for Utility Electrical Appliances

The tendency toward personal economy and thrift which is noticed generally as a result of the recent depressed condition of business is well reflected in the character of sales of electrical appliances, according to the manager of a metropolitan company carrying a very large stock of electrical devices and catering chiefly to the more discriminating classes of customers. People are now buying utility appliances rather than mere novelties, he reports. The expensive art lamps, for example, are moving slowly, but the gain in the sale of electric irons, washing machines, cooking devices, etc., has more than made up for the loss in the more esthetic stocks.

Advertising to the Landlord

Among the many "catchy" phrases used in the advertising campaigns of the Topeka (Kan.) Edison Company is one which is deemed particularly effective. This phrase is "The For-Rent Sign Comes Out Where Our Electric Light Goes In." On the street cars, in the newspapers and everywhere a landlord is likely to look in Topeka he sees this sign, and if his house lacks tenants the hint is timely.

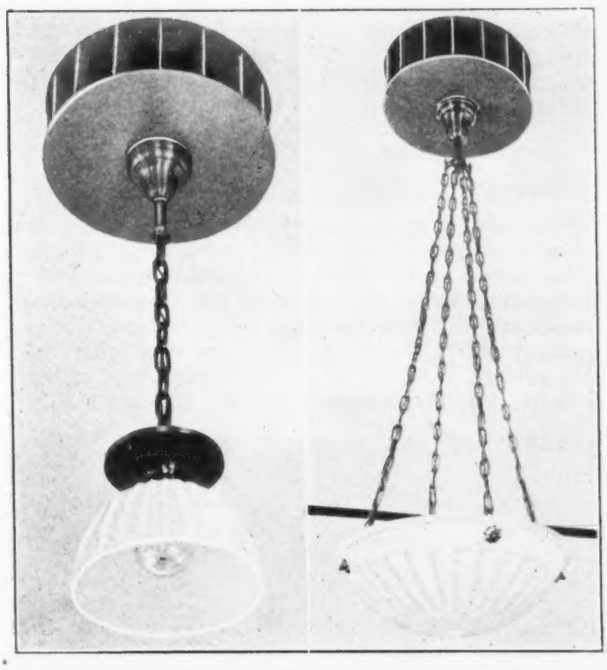
Those who live in rented houses also see these signs, and it has been found that tenants who want electric light are excellent new-business solicitors for the electric-service company. Hence the advertisement addressed directly to the landlord sometimes reaches him directly and sometimes indirectly. The ultimate result in both instances is generally the same; the tenant gets electric light and the company gets a new customer.

Free Electricity with Each Appliance

During the week of Dec. 12 to 19 the electrical contractors of Shreveport, La., co-operating with the local staff of the Southwestern Gas & Electric Company, which furnishes electric service in Shreveport, put on an electrical show similar to the one held the preceding year. A feature of the appliance sales made from the contractors' booths was the donation of free electric service with each device. The appliances were tagged with coupons good at the electric company's office for a given number of kilowatt-hours, the quantity in each instance depending upon the cost and energy consumption of the apparatus. This energy was donated by the electric company to stimulate the sale of electric appliances in the city.

Combination of Lamp Outlets with Warm-Air Diffusers

In laying out the lighting of the offices of the Evanston Railway Company, Evanston, Ill., use was made of the metal diffusing boxes which admit warm air to the room from the building heating system as supports



FIGS. 1 AND 2—FIXTURES MOUNTED ON WARM-AIR DIFFUSERS

from which to suspend the electric fixtures. The latter, as shown in the accompanying illustrations, are of both the direct and semi-indirect type. The diffusers serve as outlets for a Sturtevant hot-air system, and each sheet-metal boxing measures 20 in. in diameter and 6 in. deep.

In the case of the indirect fixture the bowl, which contains four 60-watt lamps, is hung comparatively low so that the light is well diffused over a wide area of ceiling area and the efficiency of reflection is not impaired. The direct fixture contains a single 100-watt lamp. The rubber-covered fixture wires are inclosed in conduit where they pass through the diffuser and piping, and as the heated air leaving the diffuser does not exceed 80 deg. to 85 deg. Fahr. in temperature, no special provision is made to protect the wires against the heat. One diffuser suffices for a room 16 ft. by 16 ft., while two are required for another room measuring 16 ft. by 32 ft.

Free Wiring Offer Proves Good Investment at Leavenworth, Kan.

Some time ago the Leavenworth (Kan.) Light, Heat & Power Company offered to install free of charge four single outlets with cords for drop lamps in any unwired house. In case more than four outlets were desired the first four were installed free and a charge was made for the additional labor and material. The central station's workmen did some of the wiring, but the larger jobs were turned over to electrical contractors. All material was purchased through the contractors. After this plan had been in operation a few months it was found that 238 homes had been wired with an average of five and one-half outlets per house. Data compiled at the same time showed that it had cost the central-station company $3.83 per house to secure this business, including total sales expense and wiring costs. Of course, this does not mean that the company was able to give away and install four outlets for $3.83, for there was a certain amount of profit on jobs in which more than four outlets were installed, and this reduced the average cost.

Attractive and Clear Reports Assist in Displacing Private Plants

The success of any attempt to induce consumers of private-plant energy to use central-station service depends to a considerable extent on the manner in which the comparative report regarding both systems of operation is presented. In the reports submitted to prospective consumers by the Edison Electric Illuminating Company of Brooklyn, N. Y., the estimated costs of operation with both systems are computed and printed in detail and reasons for any assumptions made therein carefully set forth. Instead of stating that so many pounds of coal must be burned to produce so many kilowatt-hours of energy at the switchboard, this company explains the intermediate steps by which it arrives at conclusions, so that no one can argue that energy can be produced more economically in the particular private plant referred to in the report without pointing out the conditions which would have to exist. With the facts printed in black and white, arguments for private plants can generally be answered in favor of central-station service. In the reports as prepared by this company the costs of operating with each system are given in detail first and followed by a recapitulated report which can be employed more conveniently in finally closing the contract.

Reports to owners of installations larger than 50 hp are bound in flexible morocco-leather covers bearing the names of the prospective consumer and the electric-service company. Being submitted in an attractive and permanent form, these reports will be kept by the prospective consumers even if they do not sign for service immediately. The name of the electric-service company will therefore be brought to the private-plant owner's attention every time he has occasion to inspect the report and may eventually cause him to consult it again with a change of service in view.

Copies of these reports are kept by the industrial engineering department and filed with reports of interviews with owners of private plants, setting forth also the ultimate outcome of the campaign. Whether a contract for service is or is not closed with the owner, the information contained in the office report may be of considerable value to new-business solicitors in negotiating with persons engaged in similar industries. If a contract is not closed, a solicitor is usually instructed to visit the prospective consumer again after some time has elapsed. With the information regarding previous

interviews available the solicitor may be able to shape subsequent campaigns so that the prospective consumer is induced to make a change. While the leather-bound reports are rather costly to prepare, it is declared that the expense is warranted as the cover has considerable advertising value.

New Year's Advertisements Urge Mutual Faith

Reproduced herewith is the copy which was employed by all Byllesby public utility properties in their newspaper advertisements on or about New Year's Day.

Prosperity in 1915 Depends Upon Faith in Our Country

¶ Our Nation is being penalized by a crisis of European methods and ideals.

¶ We cannot escape entirely the bitter fruits of a war founded in governmental systems where Monarchy, Paternalism, Public Ownership and Autocracy go hand in hand.

¶ Now as never before we have opportunity to compare American ideals and methods with those practiced in Europe and to measure what American systems and institutions have gained for humanity.

¶ Probably we will learn more and more each day of the coming year to appreciate "all we have and are," to regard our citizenship in a more precious light, to see our problems more clearly, more tolerantly.

The war has made material progress difficult throughout the United States. It has added to the obstacles of financing constructive effort. It has enforced economies upon the large and small, has laid on the shelf plans for many desirable things.

Prosperity in this country during the coming year demands above everything else faith in our Republic and faith between man and man. It cannot be had in suspicion and distrust.

If this military calamity teaches us a deeper and more useful patriotism; if it serves to advance understanding among us of one another's rights and wrongs; if it removes prejudice and strikes down distrust — then this war will not be without benefit to the citizens of the United States.

We hope for prosperity the coming year. To have it will require hard work, courage and faith in ourselves.

(Name of Company)
(Name of Manager)

A CENTRAL-STATION APPEAL TO PATRIOTISM

The text points out that America's future prosperity depends upon faith not only in our country and in its institutions but between man and man. The burden of the plea is for useful patriotism and removal of prejudice and distrust.

Price Cutting

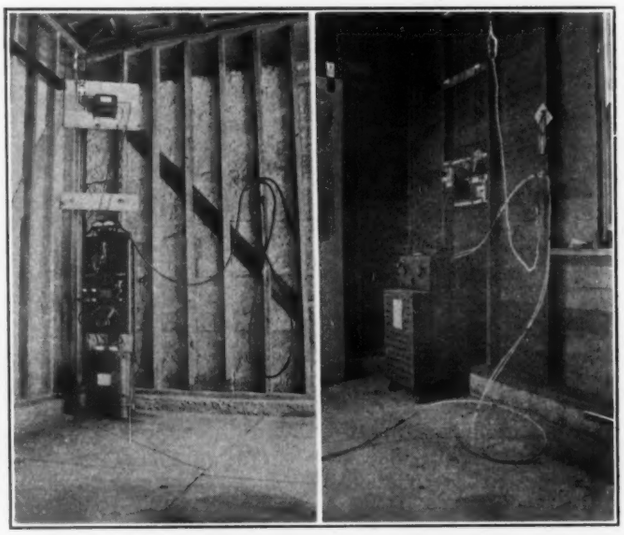
At a recent dinner given by the Edison Electric Illuminating Company of Boston, Mass., to electrical contractors of Boston Mr. R. S. Hale addressed those present upon the subject of "Price Cutting." Referring to the wiring campaign conducted by the company by which residences and stores are equipped on a unit-price basis (see ELECTRICAL WORLD, Sept. 5, 1914, page 457), the speaker pointed out that, although some contractors think the Edison price list low, the price really saves the contractor some of the expense of estimating and selling, besides all the expense of collecting, bad bills, and some interest on the contractor's money; but that no matter how low the Edison price may be, it is not price-cutting if the contractor sticks to these prices. The price-cutting that hurts business is when one contractor makes a price, the next contractor shades it, the next one cuts a little more, and so on until the job is let. Then each contractor who lost the job says, "I must cut a little more next time," while the contractor who gets the job says, "I must skimp on this job and I must catch a sucker next time."

Fixed prices such as those of the Edison list are not price cutting, even if they are so low that the contractor loses money. The contractors who do work at too low a fixed price will finally drop out, as they should, and those who insist on a higher fixed price and stick to it will be all right. The harm is done when the contractor first tries to get a high price and then cuts to a lower one, and then tries to get more profit on the next job, and keeps shifting all the time. The Edison prices apply to only a certain class of work, and scores of contractors are doing that kind of work and making money. These prices are perhaps too low for another class of work in nice houses with hard-wood floors and special wall papers; but the contractor should name his price for that class of work to give himself a fair profit only, and then if he sticks to the price and does not cut, he will get that kind of business at a fair price. If the contractor cuts on one job only, he is hurting the business. Closing, Mr. Hale said:

"To-day you yourselves wouldn't deal with a grocer or department store that was not on a one-price fixed-price basis. Only the smallest, cheapest stores will dicker with you over a can of tomatoes or a piece of cloth, and this is true, though the high-class stores have one fixed price and the second-class and third-class stores others. Nearly all the fixed-price stores make money, and only the little storekeeper who spends his time dickering on price is a failure. Let us put the wiring business on the same high basis."

Electric Vehicles in Independence, Kan.

It has been seven years since the first electric vehicle was sold in Independence, Kan., and during the intervening period orders have been placed for a total of thirty-eight others, all of which are now in service. Considering the fact that the population of the city numbers only 11,000, the above record is notable. Still more unusual, however, is the high percentage of home garaging, for only five owners among the entire thirty-nine do not keep their cars at home and do their own charging.



TYPICAL CHARGING OUTFITS AT INDEPENDENCE, KAN.

Several circumstances seem to have combined to make Independence an electric-vehicle city. In the first place, there are 27 miles of brick-paved streets in Independence. Mr. W. R. Murrow, manager of the local central station, who sold the first vehicle, has always been an ardent advocate of the "electric."

NEW APPARATUS AND APPLIANCES

Electric Hand-Lamp

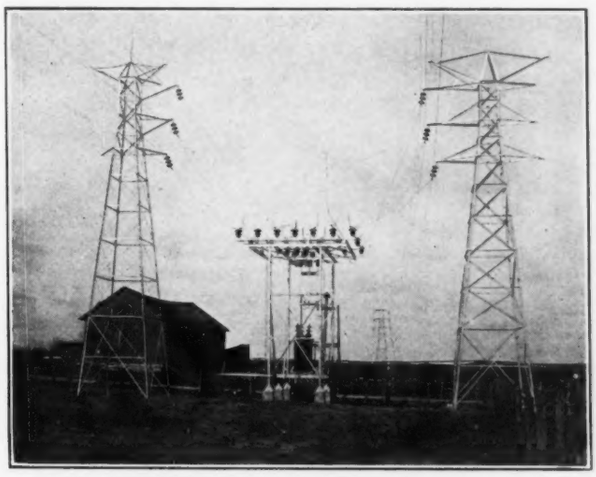
A small lamp which can be attached to an ordinary dry cell is illustrated herewith. It is provided with a handle as shown so that it can be easily carried from place to place. Use is made of a tungsten lamp, and a 2-in. "bull's-eye" reflector is employed. The lamp can

BATTERY-OPERATED HAND-LAMP

be tilted at various angles as desired. It has recently been developed by the Metal Specialties Manufacturing Company, 736 West Monroe Street, Chicago, Ill.

Steel-Tower Outdoor Substation

Herewith is shown an outdoor substation of the double-throw or selector type designed for 66,000-volt service. The station has an initial rating of 100 kw and an ultimate rating of 1000 kw. In order that the three-phase transformer used with the equipment may

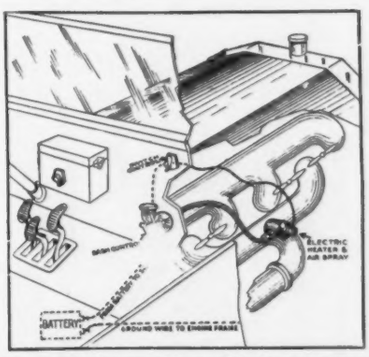


66,000-VOLT OUTDOOR SUBSTATION

be energized from either of two sources of energy, a standard transmission tower is set off the right-of-way, directly opposite the line tower shown in the illustration. One set of three-phase line conductors is carried to the right-hand tower, thus "splitting" the system and offering a ready means for carrying taps to the substation without crossing the line wires. The switches are of the interlocked selector type. Protection is secured by means of choke coils, horn-gaps and carbon-tetrachloride fuses on the high-tension side. The low-tension side is controlled by an automatic 2200-volt oil switch in a small cement house at the base of the substation. Meters, spare parts, distribution switches, etc., are also in this house. The transformer rests on a transfer table. The 2200-volt secondary leads are carried under the transformer platform into the cement house, and then pass through conduit to the overhead secondary or town distribution. The three-phase transformer used in this installation was manufactured by the Packard Electric Company, Warren, Ohio, the remainder of the equipment being made by the Delta-Star Electric Company, Chicago, Ill.

Electric Manifold Plug

An electrically heated plug for use in the manifold of an automobile engine, through which gasoline from the priming cup on the dashboard is passed before cranking the engine, has been developed by the Interstate Electric Company, New Orleans, La. The gasoline from the priming cup passes through the plug, and it is not only sprayed, the manufacturers declare, but actually boiled and vaporized into the manifold. As the



PLUG ATTACHED TO ENGINE MANIFOLD

engine is cranked over, a charge of hot vaporized gasoline rushes into the cylinders. The device is designed to make the starting operation of gasoline engines easier in cold weather. The plug may be connected to either dry cells or storage battery. In the accompanying sketch is shown how the plug is attached to the manifold and connected to the priming cup.

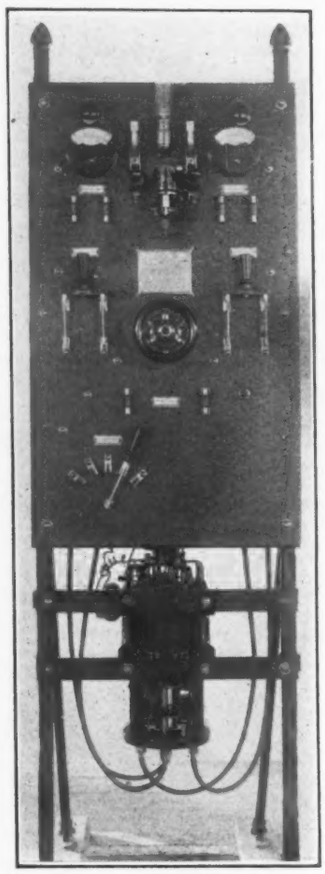
Tubular Woven Fabric

Various kinds of material can be woven in tubular form by looms made by the Chernack Manufacturing Company, Pawtucket, R. I., the fabric being used to cover cable, hose, etc. The weave may be compact so that when saturated it is almost metallic, or it may be of an open texture similar to that of a basket weave, or the weave may vary in texture between those of the two above types. The following advantages are claimed for a woven cover: Each end of the warp increases the tensile strength; with a tensile pull the walls do not collapse; the thickness of the wall is governed only by the size of yarn used; the warp and filler both used under tension make it possible in using the tube as a cover

to apply it as tightly as desired without impairing its flexibility. Successful weaving has been accomplished with cotton, cotton and paper, cotton and wire, jute, jute with marline, jute with wire, marline, marline with wire, asbestos yarns, asbestos yarns with wire insertion, linen yarn and wire.

Rectifier Operated by Synchronous Motor

A rectifier of the commutator type driven by a synchronous motor has just been developed by the Standard Metal Manufacturing Company, Newark, N. J. The rectifying commutator consists of as many conductor segments as there are field poles in the motor and just



RECTIFIER AND SWITCHBOARD

as many non-conductor segments. It is keyed to the armature shaft in such a way that the centers of the conductor segments line up with the centers of the field poles when the line voltage is at a maximum and they are centrally located between the pole pieces when the voltage is at its zero value. The rectifier brushes are so placed that they bear upon the center of the conductor segments when the voltage is at a maximum and on the center of the non-conductor segments when the voltage is at zero. The non-conductor segments are of such size that the voltage at the time the conductor segments come in contact with the brushes and also when the brushes leave the segment is the same as that of the battery.

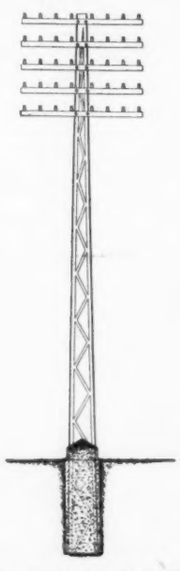
The motor is a vertical-shaft single-phase machine and is started by connecting the commutator to the battery and operating it as a direct-current machine. The speed is adjusted by means of the field rheostat wheel shown in the accompanying illustration until it reaches the synchronous value as indicated by the synchronizing lamp shown at the top of the switchboard. Then by pushing the button shown in the center of the rheostat wheel the direct-current brushes are withdrawn from the commutator and the synchronizing lamp is short-circuited. The charging switch being closed, the supply of alternating-current energy is adjusted by means of an auto-transformer to obtain the current desired in the battery.

A circuit-breaker of the double-pole overload type having a trip coil attached is provided. The trip coil is connected to a relay at the rear of the board. The magnet of the relay is in series with the line circuit of the motor, and in case the circuit is opened the trip coil will be energized and the circuit-breaker will open. The trip coil is so arranged that it will open the circuit-breaker when the charge is complete. The trip coil can also be arranged to open the breaker at any time desired. A governor on the end of the shaft short-circuits the field rheostat when the motor is at rest, thus making it impossible to start the motor with a weakened field. The short-circuit is removed by a device operating by means of centrifugal force after the motor has attained a speed of approximately 500 r.p.m. The efficiency of the outfit varies from 74 per cent to 93.5 per cent, depending upon the lead, and the weight of the 5-kw set is 40 lb.

Expanded-Truss Steel Pole

The pole shown in the accompanying sketch utilizes the principle of the expanded steel truss, the flanges, webs and lacing pieces being all formed from a single piece of steel. In preparing the material beams of suitable form are first sheared cold at intervals along the web. The metal is then heated and placed in a machine which grips the outer members along their entire lengths and by the application of tension draws out the bar laterally, thus separating the sheared members and throwing the central members into the zigzag form of a trussed structure.

According to the owner of the patents, the Bates Expanded Steel Truss Company, 208 South LaSalle Street,



POLE WITH EXPANDED STEEL TRUSS

Chicago, an expanded-truss pole of the same size and strength as a 22-ft. fabricated steel pole made up of fifty-one different pieces weighs 107 lb. less than the built-up pole, representing a saving of 40 per cent in weight. The cost of the new form of steel pole is said to be about one-third that of the built-up structure.

Pendent Switch

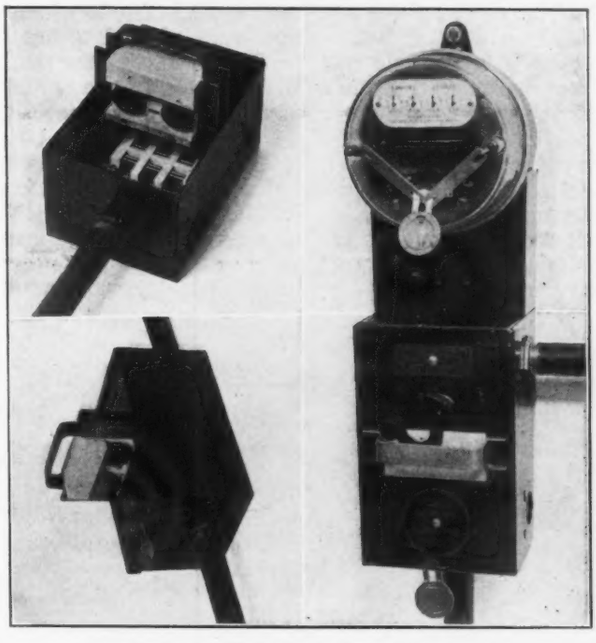
In the accompanying illustration is shown a switch of the pendent type, which, the manufacturers declare, is provided with quick, positive action. The spring con-

SWITCH OF PENDENT TYPE

tacts are of phosphor bronze metal. The switch is being made by the Union Electric Company, Hamilton Avenue, Trenton, N. J.

Inclosed Service Switch and Meter Protective Device

An inclosed three-pole service switch recently developed by the Metropolitan Engineering Company, Forty-second Street Building, New York, is shown in the accompanying illustrations. The device consists of a switch cut-out equipped with standard plug fuses and is inclosed in a metallic box which can be sealed if desired. The switch mechanism is of the double-break plunger type and is actuated by springs. The fuses and all accessible energy-carrying parts are dead when exposed, and the danger of shock when installing fuses is consequently eliminated. The switch mechanism may be sealed in the "closed" or "open" position. The box in which the unit is mounted is equipped with interchangeable conduit openings at each end and at both sides, so that several sizes of conduit may be employed

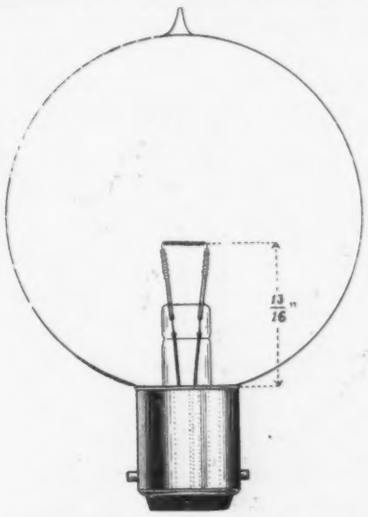


INCLOSED THREE-POLE SERVICE SWITCH

if desired. Suitable openings are also provided on the house side of the switch for open wiring. Provision is made on the end of the switch box to fasten a metallic meter-protecting device, called an adapter, the device being made to conform to the shape of the watt-hour meter used. The adapter protects all the conductors.

Nitrogen-Filled Automobile Head-Lamp

A nitrogen-filled bulb designed for use with automobile head-lamps is being made by the H. J. Jaeger Company, 68 Hudson Street, Hoboken, N. J. The filament

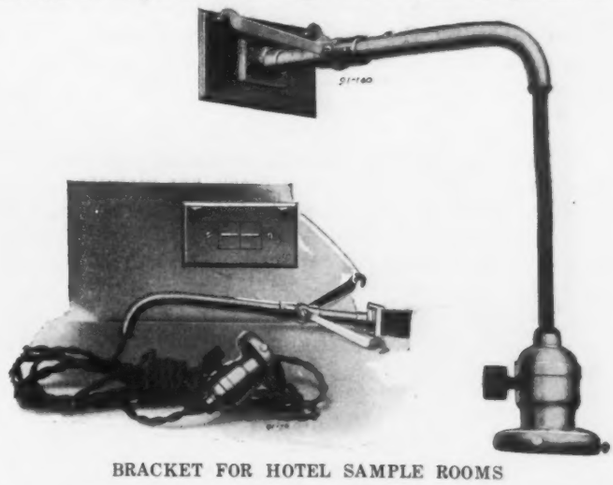


GAS-FILLED AUTOMOBILE LAMP

of this high-efficiency lamp is made of drawn-tungsten wire coiled into a helix and mounted within a very small space, concentrating the light. The lamp is in two sizes. In the illustration is shown a full-size drawing of the larger lamp. The lamps operate on from 6-volt to 14-volt circuits, giving 24 cp and 32 cp for the larger lamp and 15 cp and 21 cp for the smaller. The average specific consumption of either lamp is 0.5 watt per cp.

Removable Bracket

The bracket shown herewith is designed particularly for use in hotel sample rooms and is provided with a receptacle from which it can be removed at will. The receptacles are of the disappearing door type and are equipped with eyelets to receive the hooks of the bracket. Each receptacle accommodates one bracket. The receptacles can be entirely covered if desired by a hinged section of a picture molding. With such equipment it

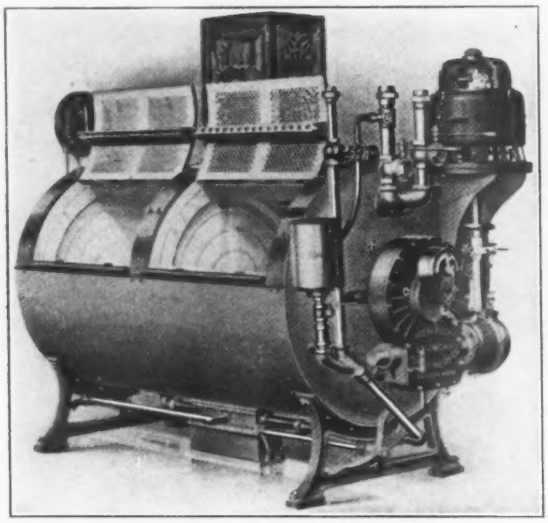


BRACKET FOR HOTEL SAMPLE ROOMS

is possible to transform the sample room to an ordinary living room or bedroom. With one of these receptacles placed near the head of the bed, the bracket can be used in connection with a bed reading lamp. The bracket is being placed on the market by the Bryant Electric Company, Bridgeport, Conn.

Large-Sized Washing Machine

An electric washer designed for use in laundries, hospitals, hotels, etc., is shown in the accompanying illustration. The machine is of steel throughout, and every part is non-corrosive. The outer cylinder is of ⅛-in. forged steel and the inner cylinder of 1/16-in. steel plate, with the inside covered with porcelain enamel.



ELECTRIC-LAUNDRY WASHING MACHINE

The inner cylinder rotates on ball bearings and is provided with over 10,000 holes to produce a powerful suction. One lever is used to control the moving of the machine forward and backward and for stopping it. This lever is also employed to operate a brake for emergency stop. An automatic timing device provided with a quick-reading dial, 15 in. in diameter, is provided for timing different kinds of washing. With this device the wash wheel can be reversed automatically from a half revolution up to twelve revolutions each way. The machine is equipped with steam valve, cold-water valve, hot-water valve and discharge valve. Two 42-in. compartments are provided and their contents are 56.9 cu. ft. Either belt or direct drive may be used, and the motor may be mounted vertically, as shown in the accompanying illustration, or horizontally if desired. The total weight of the machine is 4000 lb. The washer is being made by the Henrici Laundry Company, Boston, Mass.

Tap Block

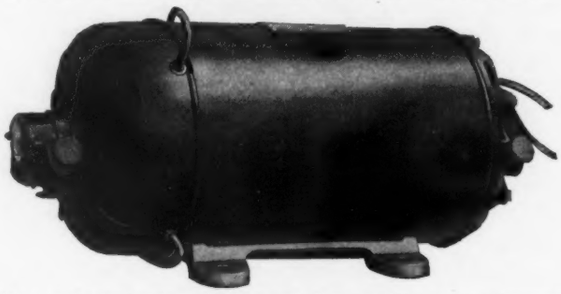
A block designed for use with so-called pipe "taplets" is shown in Fig. 1. This tap block, the manufacturers declare, eliminates the necessity for soldering either of branch wires to the main wire or of tap wires for fittings. The main wires are bared for ⅜ in. and are

FIGS. 1 AND 2—BLOCK FOR CONNECTING WIRES

fastened to the binding screws of the tap block. The tap or branch wires are fastened to the connecting binding screws. The blocks can be used with 0.5-in. or 0.75-in. taplets. The block is being made by the H. T. Paiste Company, Philadelphia, Pa., for which the Hart & Hegeman Manufacturing Company, Hartford, Conn., is the selling agent.

Motor-Generator Set for Charging Batteries

A small motor-generator set designed for charging storage batteries for use with gasoline automobiles is shown in the accompanying illustration. The alternating-current motor and the direct-current generator are mounted within the same frame. The motor is designed to operate at 110 volts and sixty cycles. The generator

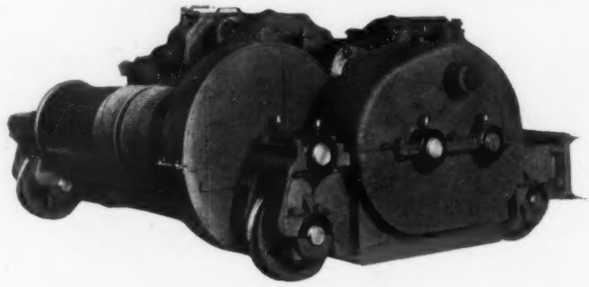


SMALL MOTOR-GENERATOR SET FOR CHARGING BATTERIES

is rated at 10 amp, and it can charge one or two 6-volt batteries or one 12-volt battery. Its emf can be regulated from 6.3 volts to 12.6 volts by means of a field rheostat. The generator is wound so that its voltage rises automatically at the end of the charge and each cell receives 2.5 volts. The length of the apparatus is 19 in., width 7.75 in. and height 8.375 in. The total weight is 140 lb. The set is being made by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Electric Crane Trolley

Certain improvements have been made in the type "E" electric crane trolley made by the Northern Engineering Works, Detroit, Mich. The machine has been made stronger and the gears and other moving parts more accessible. The moving parts are completely inclosed, and they run in an oil bath. The machine is so designed that the covers of the gear cases must be in place before they can be operated. Each train of back gears is mounted on a single frame. The hoisting-gear train from armature to drum gear is inclosed in one casting. As the gear covers are castings, joints of the inclosed gear cases are planed so as to make a perfectly tight construction, thus preventing the leakage and dripping of oil. By lifting the cover of either gear case the cap is removed, and any gear with its shaft can be quickly lifted out without disturbing other parts. Large manholes are provided in each cover so that it is not necessary to remove the gear covers for the purpose of in-

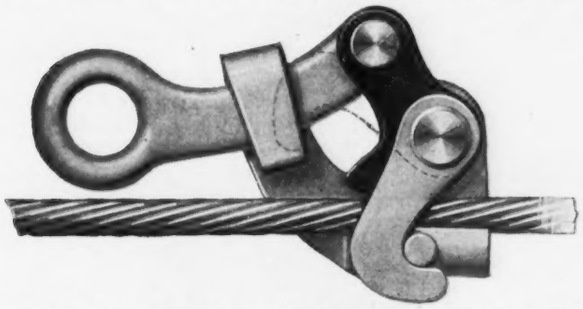


CRANE TROLLEY

specting or oiling the gearing. The hoisting-gear box is an integral part of the main trolley frame, and thus, it is declared, the alignment of all gears and their shafts is secured. A double-brake system is employed on this trolley. The wiring for the trolley is inclosed in steel conduit. Trolleys with ratings of from 2 tons to 125 tons are being made.

Wire Grip

A wire clamp or grip designed for handling plain or stranded wire or cables up to a diameter of 0.75 in. is being placed on the market by Mathias Klein & Sons, 562 West Van Buren Street, Chicago. Use is made of a

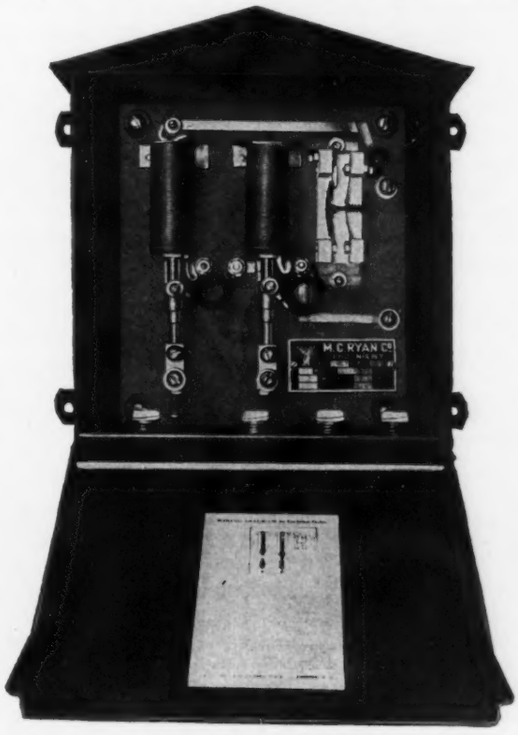


WIRE CLAMP FOR HANDLING STRANDED WIRE OR CABLE

swing latch which engages with a stud on the lower jaw, thus centralizing the pressure on the cross-bolt, which is of machine steel. The body and handle of the clamp are made of steel forging and the eccentric of hardened tool steel.

Motorless Flasher

A flasher consisting of solenoid-operated switches, the pilot circuits of which are controlled by a thermostat, is being placed on the market by the M. C. Ryan Company, Phoenix, N. Y. The thermostat is connected across the line. From one to four switches are used, operated simultaneously or alternately. Arcing at the contact points is reduced to a minimum, it is claimed,

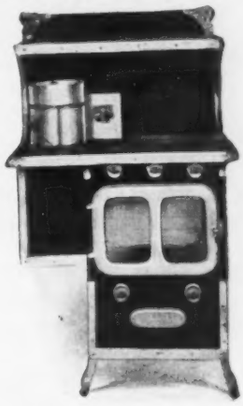


TWO-SWITCH FLASHER

by an induced magnetic field. The points are made from a composition metal which, the manufacturers declare, will neither weld nor corrode and will last several years when used on rated loads. The flasher is mounted in a No. 16 U. S. gage steel cabinet. The size of a one-switch flasher is 12 in. by 9.5 in. by 4.25 in., and its weight is 15 lb.; the size of the two-switch flasher is 12 in. by 11.25 in. by 4.25 in., and the weight is 20 lb.; the size of the three-switch and four-switch flashers is 14 in. by 16.25 in. by 4.25 in., and the weight complete is 30 lb. A two-switch flasher is shown in the accompanying illustration.

Electric Range with Glass-Front Oven

The electric stove shown in the accompanying illustration is equipped with two luminous-disk heaters and two aluminum-lined ovens. One oven has a full glass front in the doors and is used for quick baking, roasting and toasting, while the other oven is a perpendicular compartment with "water-seal" cover. Each gear is protected by fuses, and a separate switch is used in case it is desired to operate the stove with or without an au-



ELECTRIC RANGE

tomatic clock regulator. The range is made of gunmetal and has nickel-plated trimmings. Provision is made for ventilation in the oven so that the glass in the door will not be covered with condensation vapor. The range is being placed on the market by the Standard Electric Stove Company, Toledo, Ohio.

Malleable-Iron Hickey

In the accompanying illustration is shown a malleable-iron hickey which has been passed by the Under-

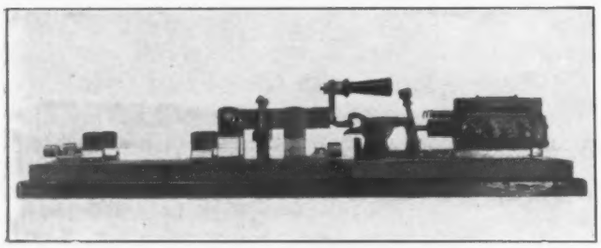
IRON HICKEY

writers' Laboratories. The hickey is used with insulating joints and the iron utilized in making it shows an average tensile strength of over 37,000 lb. per sq. in. The device is tapped to Briggs' standard gage and has been developed by the Pittsburgh Valve & Fittings Company, Barberton, Ohio.

Remote-Control Device for Knife Switches

A device designed for the remote control of knife switches of any size or any number of poles has been developed by H. S. Tittle, 245 Minna Street, San Francisco, Cal. The device will operate on either alternating current or direct current at pressures of 110 volts or 220 volts. If the device is used with a three-wire, 220-110-volt system and either side of the circuit is open,

the energy supplied to the system will be cut off. In the illustration the switch is shown closed; on being energized the plunger pulls the hook away from the switch and releases it, thereby opening the circuit. The device is adaptable to use in buildings where ordinances require that a switch for opening the circuit shall be placed near the entrance of the building.

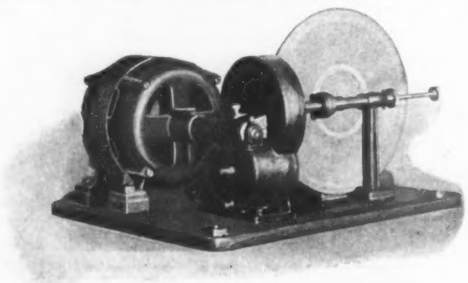


REMOTE-CONTROL SWITCH

Electric Timing Device for Elevators

The motor-driven timing device shown herewith rings a bell at intervals of a few seconds, serving as a guide for the elevator "starter" in maintaining the schedules of the cars under his supervision. In other cases the attendant is wholly dispensed with and the timing device alone is depended upon to give the signals for the elevator operators.

A small motor drives a commutator wheel through reduction gearing and a friction transmission. By adjustment of the friction disk between the center and periphery of the disk, the interval of the contact-making mechanism can be varied from ten seconds to ninety seconds. In another type of timing device made by the same company, the Elevator Supply & Repair Company, 561 West Monroe Street, Chicago, the adjustment of time interval is made by introducing resistance in series multiple with the motor armature, thus securing the speed control electrically instead of mechanically.



ELECTRIC TIMING DEVICE FOR ELEVATORS

Connector for Tying Wire

The tool shown in the accompanying illustration has been designed for tying two wires together. The tool can be used with No. 8, No. 10, No. 12 and No. 14 wires.

TOOL FOR TYING WIRE

The operator holds the tool in one hand and twists the wire with the other. For use with large wires or sleeves special openings are provided. The tools can also be used with MacIntyre waterproof joints, Holtzer-Cabot seamless joints or American Fuse Company joints. The tool is spring-tempered and is provided with a joint which is also hardened and tempered. The connector is being made by Smith & Heminway Company, 146 Chambers Street, New York.

Motion-Picture Machine

In the accompanying illustration is shown a machine for projecting motion pictures. With this projector the flicker is eliminated, the manufacturers declare, by increasing the picture impression on the eye of the observer. The film-handling mechanism is inclosed in a box with a glazed door cover. All gears are placed in a gear case. The film tension members are long, hardened-steel runners, which bear lightly against the film. The reels are supported in the base of the machine itself, and with a single screw a vertical adjustment of the line of projection, for high or low screen is accomplished.

FIG. 1—MACHINE FOR PROJECTING MOTION PICTURES

The switches and rheostats are inclosed in the hollow pedestal. The rheostat is used when a motor-generator set is not employed. A three-lens condenser system is used, there being one meniscus lens and two convex lenses. A lever handle on the left of the pedestal near the top of the machine closes and opens the main switch, and the lever on the right is used to adjust the rheostat.

A three-electrode lamp is used with this machine, the arrangement of the electrodes being shown in Fig. 2.

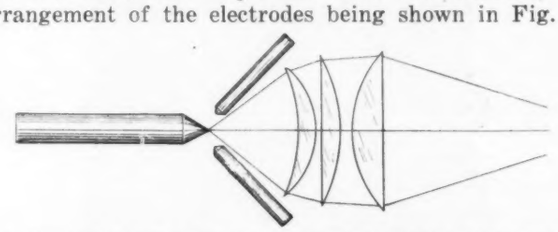


FIG. 2—ARRANGEMENT OF THREE ELECTRODES AND LENSES

Two 0.25-in. electrodes are connected to the negative lead and a 0.5-in. electrode to the positive side of the line. The small electrodes are placed at angles of about 120 deg. on either side of the positive electrode. This arrangement is used to present the largest possible area of the so-called "incandescent spot" to the condensing lenses without permitting the negative electrode to cast too large a shadow on the screen. With the electrodes in this position, the two hot arcs attract each other and bring the incandescent spot on the end of the positive electrode and therefore in the exact focus of the condensing lens. The electrodes are mounted horizontally.

The motion-picture machine described above is being placed on the market by the Phantoscope Manufacturing Company, Washington, D. C.

CURRENT NEWS SECTION

Mayor of Seattle Arraigns City's Lighting Policy

In vetoing a bill appropriating $10,000 from the lighting fund for extending the city's lighting system to Tukwila, Foster and Riverton, Mayor Hiram C. Gill of Seattle, Wash., sent with his veto a communication in which he scathingly arraigned the measure, the City Council and the entire lighting policy as conducted during the last three years. In denouncing the plan, Mayor Gill gave voice to the following sentiments:

"To say that the Seattle lighting plant is a money-making concern in the sense that it earns money for the general purpose of reducing taxation is wrong. From its inception the lighting plant has controlled the rates of this city. It has saved our business men, taxpayers and residences many millions of dollars and will continue to do so unless it is brought into disrepute and made a political plaything.

"Under this theory of outside extensions there is no reason why the city of Seattle should not engage in any other commercial business and conduct grocery stores, dry-goods stores, and other profit-making concerns. If I believed in this theory, I believe I should have the courage of my convictions and announce myself to be a socialist, pure and simple. All there is embodied in this bill is pure socialism and opportunity given to settle the grudges of certain persons arising from real or imaginary grievances against a private corporation.

"Contrary to the statements of Councilman Erickson, the lighting plant was not built from the proceeds of the plant, but from the proceeds of federal bond issues which are a lien against every foot of property in Seattle. Even though the lighting fund has paid the interest on these bonds up to the present time, there is no assurance that its earnings will continue to do so, particularly in view of the fact that the fund at the present time owes the general fund several hundred thousand dollars. The financial condition of our lighting department at the present time is due to gross financial mismanagement by the councilmanic body for the past three years. The Council refused to comply with the recommendation of former Chief of Police Austin E. Griffiths and myself and light down-town alleys, giving as a reason that it had no money, although it is now proposing to become 'wet nurse' for suburban districts outside the city limits, notwithstanding that it is far worse off financially now than then.

"I always have maintained that the plant should seek a fair return on the money invested, and the amount so earned be expended within the city of Seattle, to the end that all our people should have light at the lowest cost consistent with good business management. The tax rates of the city during the past few years have increased at a highly unprecedented rate, and we have nothing to show therefor except a street-car line which was not intended to accommodate the public and which did not even accomplish the purpose of its principal promoters of harassing a private concern, and upon this we are now losing thousands of dollars each month. As a matter of fact, there is no money in the light fund. The appropriation attempted is an illegal one and has been from its inception."

After denouncing the Councilmen for squandering the city's money, the Mayor concluded as follows:

"Not in any spirit of tumult or defiance, but in order that the people affected by this bill may not be disappointed, I desire to say to your honorable body that I recognize your right by ordinance to direct the actions of the light superintendent. However, though it may be unfortunate from the standpoint of the world uplift, your jurisdiction does not extend to Tukwila, Foster or anywhere else outside the limits of the city, and so long as I occupy my present position the departments of the city shall confine their operations within the limits of the city of Seattle."

The Federal Trade Commission

President Wilson is expected to send to the Senate any day the names of the appointees to the Federal Trade Commission. No less than 350 names were presented to the President from all the States. The facts in regard to all of these men were gone over by the President.

Among the men most likely to be named are the following: Messrs. Joseph E. Davies, Commissioner of Corporations; Albert D. Nortoni, a St. Louis lawyer and former Progressive candidate for Governor of Missouri; Henry J. Waters, president of the Kansas State Agricultural College; George F. Peabody, a New York banker and business man; Edward N. Hurley, of Chicago, president of the Hurley Machine Company and of the Illinois Manufacturers' Association; Thomas S. Felder, of Georgia, formerly Attorney-General of that State; former Governor Ansel of South Carolina, and Governors West of Oregon and Hodges of Kansas.

Commissioner of Corporations Davies of the Department of Commerce, whose bureau, under the Federal Trade Commission act, is to be merged with the commission, has not prepared any statement of policy for the bureau for the ensuing year in his annual report, made public in Washington on Dec. 28, but has instead incorporated an analysis of the powers and duties of the commission.

American Telephone & Telegraph Company Offers Stock to Employees

The American Telephone & Telegraph Company has made arrangements by which employees of the Bell System who have been in the service two years or more may purchase stock of the company at 110 on easy terms of payment. No employee can purchase more than one share for each $300 of annual wages he receives, or more than ten shares whatever his wages. The terms of payment will be $2 per share per month beginning with March, 1915, and the quarterly dividends will go toward paying for it after the deduction of interest at 4 per cent per annum on the unpaid balances.

The company has paid 8 per cent dividends for seven years, and it is calculated that dividends at this rate and the $2 per share per month payments by employees will pay for the stock in full by November, 1918. After March 1, 1917, but not before, any employee who so desires may pay the balance on his stock and receive his certificate. Should an employee leave the service or die before his stock is fully paid, the amount he has paid in plus the accumulated dividends (less 4 per cent interest) will be paid back. The company in its offer to its

employees makes it plain that none of them is under any obligation to buy stock, but it is believed that a considerable number of employees will take advantage of this opportunity to save and invest. The company has 160,000 employees.

Joint Meeting of Physical Society and Association for Advancement of Science

There was held during the present week in the city of Philadelphia a joint meeting of the American Physical Society and the American Association for the Advancement of Science. The meeting was the sixty-sixth of the American Association for the Advancement of Science, and its sessions were held in Weightman Hall, Gymnasium of the University of Pennsylvania. The meeting was the seventy-fifth one of the American Physical Society, and all of its sessions were held in Randall-Morgan Laboratory of Physics of the University of Pennsylvania. Section B of the American Association for the Advancement of Science met in joint session with the American Physical Society. The following papers and addresses were scheduled for the week:

Tuesday Morning.—"An Alternating-Current Bridge for the Measurement of the Dielectric Loss and Dielectric Constant at High Voltages and Low Frequencies," by Mr. Chester A. Butman, research department, Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.; "Influence of the Concentration of Electrolyte upon Electrode Potentials," by Mr. Arthur W. Ewell, Worcester Polytechnic Institute; "A New Method of Obtaining a Hysteresis Loop," by Mr. W. N. Fenninger, Pratt Institute, Brooklyn, N. Y.; "On Rotation and Magnetization," by Mr. S. J. Barnett, Ohio State University; "Note on Thermo Emfs in Which the Resultant Peltier Effect Is Zero," by Mr. H. C. Barker, University of Pennsylvania; "Linear Resistance Change with Temperature of Certain Molten Metals," by Mr. E. F. Northrup, Princeton University; "The Effect of Temperature on the Dielectric Strength, the Dielectric Loss and the Dielectric Constant of Paraffine Oil," by Mr. Chester A. Butman, research department, Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.; "A Preliminary Note on the Variation of Stray Power Losses in a Dynamo," by Mr. W. N. Fenninger, Pratt Institute.

Tuesday Afternoon.—Address of Vice-president A. D. Cole before Section B on "Recent Evidence for the Existence of the Nucleus Atom"; address of President Ernest Merritt before the American Physical Society, on "Luminescence."

Tuesday Evening.—Public lecture by Prof. Dayton C. Miller on "The Science of Musical Sounds."

Wednesday Morning.—"Relation Between the Energy of the Cathode Rays and the Frequency of the X-Rays Produced by Them," by Mr. William Duane, Harvard Medical School; "Thermionic Currents from a Wehnelt Cathode," by Mr. W. Wilson, research laboratory, American Telephone & Telegraph Company and Western Electric Company, New York City; "Mobility of Ions at Different Temperature and Constant Gas Density," by Mr. Henry A. Erikson, University of Minnesota; "The Radioactive Content of Certain Minnesota Soils," by Mr. James C. Sanderson, University of Minnesota; "Conducting Gas Layer at a Metallic Surface," by Mr. G. W. Stewart, State University of Iowa; "X-Rays from the Electrical Discharge," by Miss Elizabeth R. Laird, Mount Holyoke College; "X-Rays Produced by Slow-moving Cathode Rays," by Miss Elizabeth R. Laird, Mount Holyoke College.

Wednesday Afternoon.—Symposium on the use of dimensional equations, led by Mr. E. Buckingham, Bureau of Standards, Washington; "Light Due to Recombination of Ions," by Mr. C. D. Child, Colgate University; "Electric Furnace Evidence on the Relation of Spectrum Lines Having Constant Differences in Wave-Number," by Mr. Arthur S. King, Mount Wilson Solar Observatory; "The Mechanical Equivalent of Light," by Messrs. H. E. Ives, W. W. Coblentz and E. F. Kingsbury, United Gas Improvement Company, Philadelphia, Pa.; "Fluorescence of the Uranyl Salts under X-Ray Excitation," by Miss Frances G. Wick, Vassar College, Poughkeepsie, N. Y.

Thursday Morning.—"The Efficiency of Energy Transformation in the Corona Method of Precipitating Fumes," by Mr. W. W. Strong, Mechanicsburg, Pa.; "Leakage of Gases Through Quartz Tubes," by Mr. E. C. Mayer, Cornell University; "A New Method for Measuring Gravity at Sea, with Some Transpacific Observations," by Mr. Lyman J. Briggs, United States Bureau of Plant Industry, Washington; "The Oxidation of Nitrogen," by Mr. W. W. Strong, Mechanicsburg, Pa.; "The Alleged Dissymmetrical Broadening of the D Lines of Sodium," by Mr. E. A. Eckhardt, University of Pennsylvania; "Exhibit of Mechanical Models Illustrating, (a) Subdivision of Alternating Current between Two Branches in Parallel, (b) the Alternating-Current Transformer, (c) Coupled Circuits in Wireless Telegraphy," by Mr. W. S. Franklin, Lehigh University; "Some Causes of Variation in the Sensitivity of Moving Coil Galvanometers," by Mr. Paul E. Klopsteg, University of Minnesota (presented by Mr. A. Zeleny); "A New Standard Phone and Phonometer for any Pitch," by Mr. A. G. Webster, Clark University; "The Exceptions to the Law of DuLong and Petit," by Mr. J. E. Siebel, Chicago, Ill.

Thursday Afternoon.—"A New Form of Radiation Pyrometer," by Mr. S. Leroy Brown, University of Texas; "The Doppler Effect in X-Ray Spectra and Application to the Kinetic Theory of Solids," by Messrs. L. Gilchrist and D. A. Keys, University of Toronto; "On Acoustic Impedance, and an Approximate Theory of Conical Horns," by Mr. A. G. Webster, Clark University; "Vapors with Positive Specific Heat in Energy Conversion," by Mr. J. E. Siebel, Chicago, Ill.

Senate Committee Told Water-Power Bill Would Retard Development

In addition to the testimony before the committee on public lands of the United States Senate on the water-power bill which has been published in recent issues, other views have been given. Abstracts of other testimony follow:

Mr. W. V. N. Powelson

Mr. Powelson, consulting engineer, of New York, said that the proposed legislation should accomplish three main purposes—first, the delivery of power to the public on the lowest possible terms; second, delivery under conditions that insure the greatest reliability of service; third, delivery of power in the greatest volume that the market can absorb, that is to say, cheap power, good power and all the power that any one can use. If the legislation accomplishes those three main purposes, it has done all that the public interest could expect or require. Senator Clark asked whether there should be some obligation upon the government to grant the permit if the regulations were fulfilled by an applicant. Mr. Powelson said that he was absolutely in accord with that proposition because he thought that it would make money less expensive. Anything that makes financing expensive will increase the cost of energy. Between 80 and 90 per cent of the cost of generating water-

power is made up of fixed charges. Operating expenses are therefore substantially negligible. The proposed prohibition to limit the amount of energy to be sold to any one customer to 50 per cent of the total output would tend to retard development.

Mr. H. L. Cooper

Mr. Cooper, consulting engineer, of New York, said that the water-power business in general has suffered greatly in respect to profit from two very great opposing natural difficulties. The first is that the water-power business, as applied to hydroelectric work, is a new art, being scarcely over twenty years of age. In the last ten or twelve years plants with a capacity of more than 600,000 hp built upon navigable streams and upon public-land permits have been absolute financial failures to the extent that the investors therein cannot be appealed to again for the support of similar investments. In general, the water-power investments have not been a success up to date. The list of plants given by Mr. Cooper is shown in the accompanying table.

PARTIAL LIST OF WATER-POWER DEVELOPMENTS WHICH HAVE EITHER BEEN THROUGH RECEIVERSHIPS OR PROVED BAD INVESTMENTS

	Hp
Hudson River, Spiers' Falls, N. Y., Mechanicsville, N. Y.	52,000
Michigan Lake Superior Power Company, Sault Ste. Marie, Mich.	23,000
Great Shoshone & Twin Falls Water Power Company, Pocatello, Idaho	10,000
Animas Power & Lighting Company, Durango, Col	4,500
Central Colorado Power Company, Denver, Col	40,000
Wisconsin Railway, Lighting & Power Company, Hatfield, Wis.	8,000
McCall's Ferry Power Company, McCall's Ferry, Pa	80,000
Hanford Irrigation & Power Company, Priest Rapids, Wash.	4,000
Yadkin River Power Company, Rockingham, N. C	25,000
Hauser Lake (Mont.) Power Company	15,000
Chattanooga & Tennessee River Power Company, Chattanooga, Tenn.	40,000
St. Lawrence River Power Company, Massena, N. Y	60,000
Austin Dam, Texas	25,000
Stanislaus Electric Power Company, San Francisco	50,000
Whitney plant, on Yadkin River	20,000
Miscellaneous small water-powers	50,000
Alabama Power Company	70,000
Appalachian Power Company	40,000
Total	616,500

Hydroelectric securities are very unpopular in the American market. A large amount of hydroelectric securities have been sold in Europe, but the war has closed this field completely. Practically all of the $16,000,000 bonds for the Keokuk (Ia.) enterprise were placed abroad. The next difficulty in the way of water-power investment is the very serious one of competition from steam. The water-power engineer has met everywhere each six months some new invention to bring down the cost of steam power. When Mr. Cooper first went into the business $125 was a good, fair estimate of the capital cost per horse-power for a complete steam plant, and to-day it is $40. The steam engineers have not been content in reducing the cost on the capital side but have increased the efficiency of their steam units so that the amount of coal consumption per horse-power is less than one-half what it was fifteen or twenty years ago. The steam generating stations of to-day require much less repair, much less oil, much less labor than used to be the case. Steam power with all charges paid does not cost more than 40 per cent of the cost fifteen or twenty years ago. The water-powers of the United States that have to compete against the steam energy have been constructed at an average cost of about $160 per hp. Mr. Cooper emphasized the fact that he meant real dollars instead of stocks or bonds.

The present cost of the Keokuk plant is about $175 per hp. When the present possible output is all sold and the rest of the power is developed the cost will be about $120 per hp. The average cost per horse-power at Niagara Falls is about $110. Some recent extensions there have brought the average cost down. Mr. Cooper said that the average cost by steam in the vicinity of the Keokuk plant would be $24 or $25 per hp. The energy is sold in St. Louis at $18 per hp per year. Mr. Cooper presented a table showing that since March 2, 1909, new water-power plants constructed and operated on national forests and founded upon revocable permits have aggregated 15,520 hp. Outside of the public domain since 1909 plants with a rating of over 700,000 hp have been built.

Mr. John H. Finney

Mr. Finney, a director of the American Institute of Electrical Engineers and manager of the Washington office of the Aluminum Company of America, in order to show what a modern hydroelectric system comprises, described the Southern Power Company, Charlotte, N. C. With a connected load of about 100,000 hp, this company had to put in steam plants so as to have a reliable supply for the entire system. Mr. Finney said that the bill would prevent the sale of energy to a distributing system which would actually be the principal source of business for a hydroelectric company. By prohibiting the sale of more than 50 per cent of the energy to any one user it would take away the market for the large consumer. Mr. Finney said he did not know how, under these two sections, a hydroelectric company could get its business. The bill would not permit the development of a single important hydroelectric system in the United States. The term of fifty years is not too long and in a great many cases it is too short to develop a given water-power.

Mr. George Otis Smith

Mr. Smith, director of the United States Geological Survey, said that if the law strikes the mean between what will invite capital and what will protect the consumer it will be workable. Mr. Smith discussed the issues arising from the proposal to construct a hydroelectric plant on the Green River to provide for irrigation and for the electrification of part of the Denver & Rio Grande Railroad.

A statement regarding this project was made by Mr. S. Z. Mitchell, president of the Electric Bond & Share Company, who was attending the hearing. He said that it was proposed to supply the energy for the Denver & Rio Grande Railroad from several projects, including the Utah Power & Light Company and the Green River projected plant. In the winter time, Mr. Mitchell said, there was a very large amount of power which could not possibly be used for irrigation that was absolutely wasted and it was this that was wanted.

Mr. Walter L. Fisher

Mr. Fisher, ex-Secretary of the Interior, said that it would be in the nature of a public calamity to the country as a whole, and especially to the West, if the opportunity to pass a fair and reasonable water-power bill should fail either through the unwillingness of certain of the power interests to accept what seem to be not only right but inevitable provisions in the public interest or through any failure of the Senate or the House to understand the view of those who have been attempting to advocate that sort of public protection. The fact that the transmission of hydroelectric energy over long distances has now progressed to such a point that this business is tied up and has become largely interstate in character cannot be changed by any legisla-

tion. It can only be recognized and dealt with by legislation. It is exactly the same as the situation has been in the railroad world. It is an inevitable economic development.

Mr. Fisher expressed the opinion that this bill, if enacted and accepted by the power people in good faith and administered as it will be in good faith, will be of incalculable financial advantage to them and will permit development and investment. If things that are really in the public interest are not inserted in the law, there will be public dissatisfaction and unrest until they are put in. The assurance of stability in the enterprises on a fair basis is of far more importance to the investor than any of the reservations in the bill. If the power people will cease to oppose those things which are in the public interest and direct the attention of the public to such things as the importance of obsolescence, how the investments are required to be replaced and the uncertainty of the market, and matters of that kind, all of which affect the question of compensation to be exacted and the question of how far the rates should be lowered by regulation, they will protect their interest far better than by raising questions about matters which, on correct theory, ought to be in the grant.

Commenting on the statement of Mr. Fisher, Mr. S. Z. Mitchell said that the most important matter is to get the capital. If the money cannot be obtained, all of the other points are of no avail. Stability is of very much more importance than yield. It is vital to have a law under which the people feel that the government has some solicitude, not as to how much will be obtained on the value of the securities but on the machinery that goes into the property. With this cloak of government solicitude around it people will have confidence in it, and then the money can be obtained more easily and at a much lower rate. Mr. Mitchell asked Mr. Fisher if the policy of the city of Chicago in its franchise negotiations with electric railways had not created confidence and been effective. Mr. Fisher replied that it had.

Mr. Mitchell said that the law ought to be so designed in the first place that the investor would be perfectly safe in feeling that nobody would confiscate the investment at the time of acquisition. The statute ought to make this so clear that there should be no question about it. Every possible safeguard ought to be thrown about the proposition so that, because provision has been made for obsolescence and other charges, the investor will be certain to get his principal. There is a good deal of question as to whether if the investor were not able to amortize the investment and provide for obsolescence during the last four or five years he would get his money back. Mr. Mitchell said that in case of acquisition of the electric railways in Chicago the purchaser would assume the outstanding bonds. Mr. Fisher said that such a provision ought to be included in the water-power bill.

Mr. Mitchell said that nothing of that sort was in the bill. Of course, the clearer the security is the cheaper is the capital cost.

Mr. Dennis T. Flynn

Mr. Flynn, a banker of Oklahoma City, Okla., testified from the standpoint of one who has been interested in electrical properties and who has purchased for his own use and benefit electrical securities. If this bill as it was passed by the House should go on the statute books it would mean an increase of bureaucracy, more clerks in Washington and the expenditure of more hard-earned dollars of the man who undertakes to make development by compelling many a lonely pilgrimage to the shrine of the Department of the Interior. The committee should not pass a bill applying only to interstate corporations that deal with government property and leave the corporation that is doing an interstate electric business on private property free from Congressional regulation.

Mr. Flynn took up the provision that "leases for the development of power by municipal corporations solely for municipal use shall be issued without rental charge." He said that the language should be more specific in defining "municipal use." He is interested in a company that furnishes electrical energy generated by steam. The opinion prevailed among many people who were not dissatisfied with the company that they wanted a municipal plant. They built a dam and a small power plant which furnished the energy for the city and took the best of the market in the business district. The consequence is that the company lost $30,000 in the operation of its plant and the city lost in the operation of its plant. Unfortunately the city does not keep its books as the company does. When it has not sufficient money the difference is lost in the general taxes. Mr. Flynn declared that cities ought not to be encouraged to vote bonds unless for municipal public use and that Congress ought not to authorize a city to take rights free as against an individual and by public taxation to make up a deficit.

In states where there is a public service commission the report made to that commission should be accepted by the Secretary of the Interior.

Mr. Clarence M. Clark

Mr. Clark, of Messrs. E. W. Clark & Company, Philadelphia, said that unless the bill is so drawn as to attract capital it will absolutely defeat its own purpose. Procedure has been had upon incorrect premises, one of which is that there exists in the country a great water-power trust, sometimes called an electric trust. The evidence of this is given in the shape of interlocking directorates, and very inaccurate testimony has been submitted before the committee which has considered this question and in magazines and other public prints. Mr. Clark said that for the twenty years that he had been in this business and the longer period that his firm had been in it he had never known of any such trust. The evidence which has been submitted to demonstrate that such a trust exists is absolutely incorrect. Men are chosen for directors because of their knowledge of the business and their ability to be of service and their intelligence in that line of business.

In view of what he had said in regard to the apprehension that such a trust exists in the country, Mr. Clark thinks that the bill is drawn to prevent operation under it by existing corporations and with the idea that additional capital and new men can be induced to take up this line of development. The experience of the last few years has shown that the actual construction cost of water-power has been much more than was contemplated by the original conceivers of the enterprises. The cost of coal-generated and steam-generated power is constantly decreasing at a really remarkable rate. As an evidence of that Mr. Clark said that he had refused in the last few weeks to consider a proposition in the center of one of the greatest markets in an Eastern state because a steam-generated power plant can furnish power cheaper and better than a hydroelectric plant or a number of hydroelectric plants. The enterprise was one which would have cost $8,000,000 to $10,000,000.

The value of water-powers developed on public lands is represented by what they can get for their output. The price which they can get for their output depends upon the price at which a similar output developed by hydroelectric plants not situated upon the public domain can be obtained and the price at which a similar output can be purchased when generated by steam. The development of hydroelectric plants as a separate

distinct enterprise without an established market or without connection with a market is almost invariably a failure. In this country not one large hydroelectric plant that has been put in operation within the last year or two has earned 6 per cent interest on its actual cost. There is a very great misapprehension in regard to the value of the plants. There has never been a time in the history of the country when the details and conditions of new construction enterprises have been scrutinized so carefully and closely as they are to-day. The regulatory measures which have been passed have greatly reduced or largely eliminated the profit in the public utility business and the banker who is going to invest money will consider that element very carefully. The money which has been lost in the depreciation of the securities of public utility companies as a whole throughout the country amounts to hundreds and hundreds of millions of dollars.

The reasons which Mr. Clark outlined demonstrate the necessity for legislation free from unnecessary restrictions in order to induce the investment of capital in the development of the enterprises. Financing by bonds and the issue of stock as a bonus has been largely or almost entirely superseded in this country by conservative methods. To enable the bankers of an enterprise to obtain the capital there must be long tenure of title.

The building up of the water powers of the West is desirable for three reasons—first, to conserve the coal and oil resources of the country which when used up are exhausted; second, to assist in bringing manufacturing enterprises to the Western country; third, to supply the requirements of public utility companies which are so intimately connected with the progress and upbuilding of the Western States.

Lighting Company Must Protect Its Service Against Lightning

The Supreme Court of Georgia in the case of the Columbus Railroad Company versus Kitchens (83 S.E., 529) affirmed the judgment given by the Superior Court against the defendant and held that where an electric-light company maintains overhead wires to supply light to a residence it must employ such approved apparatus as is reasonably necessary to prevent injury from electricity generated by a thunderstorm.

The action was brought against the company for personal injuries due to a shock received by the plaintiff when lightning struck the apparatus used by defendant in conducting the electricity to plaintiff's residence. A demurrer filed by the lighting company complained that no cause of action was set forth in that the petitioner did not allege (a) any breach of duty to petitioner, (b) or that the defendant was not in exercise of all ordinary care and diligence due the plaintiff, (c) or any fact showing that the wires were not in a safe condition, (d) or specifically any acts of negligence or definitely how or in what manner the defendant was negligent. Other grounds of demurrer were that it appeared from the allegations of the petition that the injury was a result of an unavoidable accident and that it was the result of a stroke of lightning; that there were no allegations that the injury would have been averted by any kind of installation, ground wires or lightning arresters, and that it was not alleged that the wires running into the plaintiff's residence were not properly insulated, nor was it alleged what it takes to constitute proper installation. The court ruled that a petition in an action against an electric-light company for personal injuries due to a shock received by the plaintiff when lightning struck the apparatus used by defendant in conducting the electricity to plaintiff's residence was not demurrable for failure to state a cause of action.

St. Louis Company Refunds Customers' Deposits

Announcement was made on Dec. 14 that the Union Electric Light & Power Company, St. Louis, Mo., would not thereafter require the customary $5 deposit from applicants for residence service and would refund all such deposits then on hand with interest at 6 per cent. The total amount to be thus refunded was about $10,000. Coming at the holiday season, the money returned seemed almost like a Christmas present to many of the recipients who had made their deposits several years ago and had partly forgotten the matter.

In speaking of the company's determination to assume without a guarantee deposit the risk entailed in customers' accounts, Mr. A. C. Einstein, vice-president and general manager of the electric company, said that the average bill of residence customers was only $2 a month and that the smallness of the bills and the general honesty of the patrons rendered it unnecessary to require a deposit.

Reports on Municipal Controversy at Saginaw, Mich.

Reports on the suggested municipal electric plant and the proposal of the Saginaw Power Company, of Saginaw, Mich., have been made by Messrs. R. F. Johnson, commissioner of light, water and sewers, and Herman H. Eymer, city engineer, and Prof. M. E. Cooley, of Ann Arbor, Mich. Mr. Eymer says that it is deemed possible for the city to obtain energy from some power company at wholesale, delivered at the switchboard at a rate less that that at which the city can produce it. Therefore it would be unwise to construct a power station for the purpose of generating energy before it is determined whether or not the energy can be purchased at a less unit cost than that at which the city could produce it. There is a further possibility of government ownership of hydroelectric plants.

In investigating the plans and estimates of Mr. Eymer, Professor Cooley availed himself of the services of Prof. H. C. Anderson and Prof. C. H. Fessenden, of the University of Michigan. After study of the figures of cost, which included for power house, power equipment and distribution system 8 per cent for contingencies, 5 per cent for engineering, supervision and inspection, and 2½ per cent for insurance and taxes, and for lamps 10 per cent for contingencies, engineering, supervision and inspection and 2½ per cent for insurance and taxes, they recommended that there be added the following additional percentages: Organization, administration and legal expenses, 2½ per cent; interest during construction, 4 per cent. The one great chance, he said, for misunderstanding in estimates of the costs of public utility plants arises in connection with the overhead charges. With the possible exception of a few items, costs of construction and putting into successful operation a utility plant are the same whether the plant be built and owned by a private corporation or by a municipality. The superior credit of a municipality ordinarily results in reduced costs of financing and lower bond interest, and there may be some other saving due to the more friendly attitude of the people toward what they themselves own. But offsetting these are sources of possible losses in operation which those best acquainted with municipally owned plants are familiar with. The lack of incentive to save often results in placing the municipally owned plant at a disadvantage

when compared with a privately owned plant. City taxes, paid by a private corporation, must also be paid by the publicly owned plant, if not directly then by an equal amount spread on the tax roll. The cost to run the city has not necessarily been decreased. Likewise there must be at hand the necessary stores and supplies to keep the plant running and a sufficient working capital to meet the pay roll and current obligations and to make necessary repairs. Then, too, there is the cost of establishing the business. The early losses are usually referred to as the cost of establishing the business or the cost of procuring a going concern. There are other costs of establishing the business, such, for instance, as are involved in securing patronage.

Professor Cooley also raised a point regarding the advisability from an economic standpoint of duplicating capital already in the field. The plant proposed will do a part or the whole of the work now being done by the present privately owned plant. Only one plant is necessary. Would it not then be a wise precaution, before making this duplication, to exhaust to the very end every possibility of getting together? If no satisfactory agreement is found possible, would it not then be better to try first to buy the existing plant outright or such part of it as may be needed to carry out the city's plans? The whole thought is the saving of several hundred thousand dollars at a time when a waste of money ought not to be afforded.

Professor Cooley also suggested that the Railroad Commission, if it has not the power now, no doubt will after the next Legislature has met have the power to adjust just such differences as confront the city and the company. A year's delay with such a possibility in prospect ought to be worth considering. His estimates of cost are as follows: Power house, $226,527; distribution system, $378,692; lamps, $159,095; total, $764,-314; office furniture and fixtures, $1,686; horses, vehicles, etc., $10,000; stores and supplies, $20,000; working capital, $40,000; total, $836,000.

Maine Public Utilities Act

At the recent general election in Maine the public utilities act passed by the 1913 Legislature was accepted by a referendum vote. The statute provides for the appointment by the Governor of a board of three members to be designated the Public Utilities Commission, the chairman having a salary of $5,000 per year and the other two commissioners $4,500 each. The chairman first appointed is to have a term of seven years and the other members five and three years respectively, subsequent appointments being for seven years. The clerk is to receive $2,500. The office is to be at the Capitol in Augusta. The right to employ expert assistance is accorded.

Power is given to the commission to inquire into the management of all public utilities, including common carriers, gas, electric, telephone, telegraph and water companies, wharfingers and warehousemen. The board or its representative receives power to inspect books, papers, etc., to require the production of these, to investigate any neglect or violations of law by public utilities or their employees and agents, reporting all violations to the Attorney-General, who, with county attorneys, is required to aid the commission.

All rates are to be reasonable and just, taking into account the value of the property with a fair return thereon, its rights and plant as a going concern, business risk and depreciation. Accounts are to be kept in the manner and form prescribed by the board, consideration being given by the latter to systems established by federal law, commissions or departments, and any system authorized by a national association of utilities. The board may order separate accounts for subsidiary business. Utilities having no property within the State other than is employed there in transit are exempted from keeping accounts in the manner prescribed by the commission, but are required to appoint a resident agent. Accounts other than those prescribed or approved for use by the commission are expressly prohibited.

Copies of rate schedules must be on file in every station and office of each utility and open to the public. Extended provisions are made against rebates or other preferential rates, although carriers may grant free or reduced rate transportation as provided by Congress and utilities may make special rates to employees or in emergencies and, on approval of the board, reduced rates for benevolent purposes. The commission is required to provide a comprehensive classification of service for each utility, which may take into account quantity, time of use, purpose, etc.

Provision is made against the furnishing of service by newly organized corporations without consent of the commission in places where a similar service is being provided. Fatal accidents must be reported by wire. The commission is required to make early investigation of accidents and in its discretion to investigate accidents resulting in personal injury or property damage. Power to value property is given, and the issue of securities is placed under the board's jurisdiction. No order authorizing the issue of securities shall limit rate-making powers. Notes for less than one year may be issued without reference to the board. The commission may order physical connections, joint rates and the joint use of equipment for a prescribed compensation.

Complaints in writing signed by ten parties against rates, service, regulations, etc., require action by the board if it is satisfied that the petitioners are responsible. No order can be issued without a public hearing after at least ten days' notice to the utility. Full power to fix rates and regulate service is vested in the board, which may investigate upon its own motion and enforce its orders.

Appeals from decisions may be taken to the Supreme Court. The burden of proof is placed upon parties adverse to the commission and upon advocates of rate increases. The act abolishes the Railroad Commission and State Water Storage Commission and vests their powers, duties and privileges in the newly created Public Utilities Commission.

Governor Haines of Maine has appointed members of the commission as follows: Messrs. Benjamin F. Cleaves, Biddeford; William B. D. Skelton, Lewiston, and Samuel W. Gould, Skowhegan.

Model School Room Lighting at Springfield, Mass.

In the new High School of Commerce at Springfield, Mass., the electric-lighting installation will be selected on the basis of competitive installations of fixtures in so-called model rooms, each of which will represent the best efforts of a single manufacturer. The city property committee has arranged with a number of firms for the equipment of several rooms with combinations of indirect and direct lighting, and the trial installations will be made in a very short time. The city authorities have been making extensive studies of schoolroom lighting during the past year with a view toward reducing eye strain and obtaining more efficient illumination for a given energy expenditure. The service is generally supplied by the United Electric Light Company.

Daylight-Saving Movement at Chicago

The Chicago Association of Commerce has instituted a campaign to give Chicago Eastern time in an effort to start the local business day an hour earlier, thus adding an hour of natural daylight at the close of the working period and reducing the use of artificial illumination. At a meeting of bankers, business men, manufacturers, railroad executives, merchants and others, held at the LaSalle Hotel Dec. 7, the advantages and disadvantages of the plan were discussed by a number of speakers.

Trade Prospects in South America

That the European war has opened the way to manufacturers of this country for the establishment of permanent business relations in South American countries is the opinion of officials of the National Lamp Works in Cleveland. They believe that merely to make arrangements to take orders for the present and supply merchandise that has heretofore been purchased in Europe would be of little benefit. Possibilities in those countries must be cultivated and the first buyers must be made customers, so that they will not use our manufactures only as a makeshift until the factories of Europe are opened, but will look to them for the future.

The manufacturer who will establish himself in Latin-American countries in such a manner as to give the service that goes with his business in this country will succeed, they believe. Up to this time nothing seems to have been done but to take orders and deliver merchandise, with the exception of providing financial accommodations for customers; but if American corporations would give the service there that they give here they would be far ahead of any Europeans in the estimation of customers. This service would make permanent customers and would hold them in competition against other countries.

It is possible, they believe, that American banking facilities would be extended to those countries if industrial concerns should develop business that would warrant such a step. Bankers might be willing to establish themselves and grow with the extension of other lines of business. The Germans have owned most of the banks for some years, and they were established to take care of the business of German exporters. It would be impossible for them to meet the demands of business from American or other exporters and, from the standpoint of the American business man, this would probably not be desirable.

Business should be established in a conservative way, and development should take place as rapidly as conditions warrant. Germany has built up its business in those countries as a result of most careful preparation. Its consuls are trained. They are taught their duties carefully and study the way business is done in the countries to which they are to be sent, the articles produced there, the cost of production, the merchandise imported and where it is secured, the cost and quality of such articles or merchandise, and many other particulars that will aid them in developing business for the manufacturers and exporters of their own country. A constant supply of information is thus going forward and is used not only in the improvement of the manufactured goods and handling of merchandise, but in opening new avenues and developing new articles.

Several languages have been taught in the German schools. This knowledge is very important to those who are engaged in foreign countries and in offices at home where extensive correspondence is conducted. School children gain some idea of people and countries through the study of languages and are better prepared for duties which they may be called upon to discharge in later life.

Some of the universities and schools of Germany have made a practice of sending students on tours of various countries. They are thus imbued in their formative years with the idea of extending business over the world and secure knowledge that they could not get in any other way. When their student days are ended they are in position to enter upon work that would be difficult or perhaps impossible to the ordinary college-trained man here.

Business methods have not been developed along these lines in this country to the extent of the progress in Germany, but there is little doubt that with co-operation between business interests and the government surprising results could be achieved.

Utah Franchise Situation Settled

The officers of the Utah Light & Traction Company and the City Commission after more than two months of negotiations have reached an agreement with reference to consolidating the franchises of the Utah Light & Railway Company and the Merchants' Light & Power Company, both of which have been acquired by the Utah Light & Traction Company. In consideration of the transfer of these franchise rights to the new company substantial reductions in rates are made to the citizens of Salt Lake City amounting to as much as 20 per cent in the case of certain customers, the minimum reduction being 10 per cent and the average about 12 per cent. Under the ordinance as passed by the City Commissioners on Dec. 21, the company agrees to furnish the standard 4-amp luminous-arc lamp at a price not to exceed $4.75 per lamp per month when fed from underground circuit and $4.50 per lamp per month when fed from overhead lines.

Standard multiple-arc lamps for commercial purposes are to be furnished at a rate not to exceed $8 per lamp per month for all-night service, $5 per lamp per month for midnight service and $4 per lamp per month for 10 o'clock service. The base rate for incandescent lighting service by meter is reduced from 10 cents per kw-hr. to 9 cents per kw-hr. and a minimum charge of $1 per month is provided, also a discount of 10 per cent if bills are paid within seven days from date. The company agrees to furnish the city with twenty-five standard arc lamps free, and also to furnish free electrical energy for lighting purposes up to any amount not exceeding 400,000 kw-hr. per annum. The furnishing of this free service, however, is conditioned upon the company receiving and having the contract to furnish the municipal street lighting. The company further agrees to furnish the city with 62½ hp of electrical energy free for motor purposes and to furnish such additional energy as the city may require for pumping and other municipal purposes up to 125 hp at a price not to exceed 1 cent per kw-hr. for service twenty-four hours a day, provided that none of the energy purchased or obtained is used for lighting purposes. From Jan. 1, 1915, to Aug. 24, 1937, the company must pay an income tax at the rate of one-quarter of 1 per cent upon the gross revenues of the company derived from the sale of electrical energy for lighting purposes. For the remaining period of the franchise the tax is increased to one-half of 1 per cent upon the gross revenues from electric lighting.

It is further provided that should the volume of the company's business increase to an extent that will reduce the cost of furnishing electricity the city and the company shall jointly appoint an arbitration committee to determine an equitable rate, such rate to be accepted by the company.

Miscellaneous News Notes

Proposed Change in Patent Law.—The American Patent Law Association has prepared a bill for presentation to Congress which provides for the temporary extension of the time of filing applications for letters patent and registration in the Patent Office and fees therefor.

Efforts to Bond Electrical Contractors in Michigan.—Upon the recommendation of the Michigan Builders and Traders' Exchange, a law will be proposed that will compel all electrical contractors to give a bond where the amount of a contract totals $2,000 or over. This is said to be for the purpose of eliminating the unreliable contractor.

Special Street Lighting for San Diego.—Plans for providing arches of electric lamps over two of the principal streets in San Diego (Cal.) have been favored in an ordinance recently passed by the City Council. The special street illumination is intended for the exposition. Energy will be supplied by the San Diego Consolidated Gas & Electric Company.

Gas and Electric Club for Louisville Company Employees.—Manager Donald McDonald, of the Louisville (Ky.) Gas & Electric Company, has appointed a committee to organize a gas and electric club for the employees of the company. It is planned to broaden the objects of the commercial meetings which have been held every Saturday afternoon so that every employee will be interested. Accident prevention will be included in the scope of the club.

Single Residence Requires 171 Hp.—The late Charles G. Gates' residence at Minneapolis, Minn., has one of the largest connected electrical loads of any home in this country. The lighting load alone is over 90 kw and the motor load is about 50 hp. Among the purposes for which electricity is used are the following: Ventilation, operating elevators, driving laundry and refrigerating machinery, and pumping air for a pipe organ. The interior illumination is very elaborate.

Keeping Food Hot in Electric Delivery Wagons.—Electric delivery wagons equipped with electrically heated compartments are being used in Germany for conveying hot foods from bakeries, caterers, municipal kitchens, etc., to customers' premises. The foods are kept in pots, cans or other suitable containers and are warmed by electric heaters while they are being transported. Large institutions, such as hospitals having several scattered buildings, can thus avoid maintaining small kitchens in each building by employing electric delivery wagons equipped with electric heaters. Delivery wagons so equipped also enable caterers to supply hot food for banquets without setting up temporary kitchens at the serving place.

Examination for Junior Telegraph and Telephone Engineer.—An open competitive examination for junior telegraph and telephone engineers will be held by the United States Civil Service Commission on Jan. 20, for positions in the Interstate Commerce Commission. The salary for grade No. 1 is $1,200 to $1,680 per annum; grade No. 2, $720 to $1,080 per annum. Competitors will be examined in the theory and practice of telegraph and telephone engineering, including overhead and underground construction, office equipment, systems of operation, and in mathematics used in this branch of engineering not including calculus. Those interested should apply for Form 2039 for the examination for junior telegraph and telephone engineer, United States Civil Service Commission, Washington, D. C.

Temporary Electric Danger Signals.—Cicero, Ind., is not a Latin village but a very wide-awake Hoosier town in which sand heaps, brick stacks and lumber piles occupying the streets in front of buildings under construction are designated at night by electric lamps incased in red coverings. The smoky oil lantern surrounded by a fragment of discarded red-flannel shirt has gone from Cicero, and when the workmen leave work for the day they have but to turn a snap switch placed in a box on a nearby tree to be sure that the unused materials will not present a menace to the street traffic in the night. Energy for operating these lamps comes from the central station of the Noblesville (Ind.) Heat, Light & Power Company, about 6.5 miles distant, and is sold through a distributing system owned by a citizen of Cicero.

Telegraph and Telephone Inspector.—The United States Civil Service Commission has announced an open competitive examination for telegraph and telephone inspector for Jan. 12. As a result of this examination three registers of eligibles will be established with salaries ranging from $1,200 to $1,800 per annum. It is desirable for eligibles to have had general experience in the construction, maintenance and operation of telegraph and telephone plants and to be qualified to enumerate and to determine the quantities and the class or grade of materials used in such construction and the quantity, character and cost of the labor required in the installation thereof. Applications should be made to the Civil Service Commission, Washington, D. C., for Form 1800 for the examination for telegraph and telephone inspector.

Research Fellowships at the University of Illinois.—At the close of the current academic year there will be available four research fellowships in the engineering experiment station of the University of Illinois. These fellowships, for which there is an annual stipend of $500, are open to graduates of approved American and foreign universities and technical schools. Nominations are based upon the character, scholastic attainments and promise of success in the principal line of study or research to which the candidate proposes to devote himself. Application should be made not later than Feb. 1. Preference is given to those applicants who have had some practical engineering experience following their undergraduate work. Additional information may be obtained from the Director Engineering Experiment Station, University of Illinois, Urbana, Ill.

Kentucky Municipalities Sue on Street-Lighting Contracts.—Two Kentucky municipalities are at odds with the electric-lighting companies which have been serving them, and both have brought suit for reparation for alleged overcharges. In both cases there is involved the question of whether lamps that do not give the candle-power specified in the contract fulfil that contract. One overcharge claim, that of Frankfort against the Kentucky Public Service Company, is for approximately $52,000, the city alleging that this amount has been overpaid to its predecessor, the Capital Gas & Electric Light Company. The other case is that of the city of Princeton against the Princeton Electric Light & Power Company for about $7,000. In the latter case it is asserted that though the contract has called for 2000-cp lamps at $72 per annum for the last five years, the city has been getting only 400 cp. for that price.

Happy Termination of a Rate War.—In a certain little Kansas city having a population of less than 1000 there are two electric-light plants. One is owned by the city and the other by private interests, and for some time a vigorous and aggressive rate war has been waged, bringing prices down to 2 cents per kw-hr. and less. With such rates prevailing there was, of course, little probability that either plant would make ends meet. It seemed fair to suppose that one if not both would soon be bankrupt, but a compromise has so far postponed the day of double default, for now each of the plants is taking its turn at serving the entire number of electric-service customers in the community. The municipal plant operates twelve hours a day, carrying all of its own and the other company's customers, and the privately owned plant takes the load for the next twelve-hour shift.

What Is a Kilowatt?—In plain language the Greenville (Tenn.) *Sun* offers its readers the following explanation of the method of figuring one's electric-lighting bill. First, "multiply the current by the conscience of the proprietor of the electric-light plant, divide this by the meter on the wall, and add whatever you can't multiply. The answer will come in dollars and cents. Just divide these by the price you pay per kilowatt and multiply again and find out what a kilowatt is. It is something you can't see, that you pay for according to what some one tells you who doesn't know what he is talking about, and he proves it by the meter that runs by guess and by thunder and is attached to the wall by a hired man with machine grease on his nose. You know just how many kilowatts you have had, just what they cost you apiece, but you don't know what they are, what they look like, who made them, or what shape they are."

Associations and Societies

Utah Electric Club Lunch.—The regular luncheon of the Utah Electric Club at the Commercial Club, Salt Lake City, Dec. 24, was given over to "high jinks." A musical program was furnished by the Fred C. Graham Lyceum Bureau, consisting of popular songs, in which the members joined. Mr. "Hy" Dunbar, the popular comedian of the line and service department of the Utah Light & Traction Company, furnished one of his characteristic monologues containing numerous hits and take-offs on local electrical celebrities.

American Institute of Consulting Engineers.—The annual meeting of the American Institute of Consulting Engineers, Inc., will be held Jan. 19 at the City Club, New York City. Three members of the Council will be elected, reports of the Council and of special committees will be presented, and ballots will be canvassed for the adoption of amended constitution and by-laws as prepared by the special committee appointed at the last annual meeting. The meeting will be preceded by an informal dinner of the members of the Institute at the same place. Mr. Eugene W. Stern, 101 Park Avenue, New York, is secretary.

Woes of the Electric Garage Man.—Some of the troubles of the electric garage owner who attempts to give his customers on-the-minute service at any time of the day or night were narrated by Mr. Harry Salvat at a recent meeting of Chicago electric-vehicle men. About 1 o'clock one rainy night a woman customer living two miles away telephoned for her electric car, requesting that the boy who delivered it ring her doorbell on his arrival. As the night was a bad one and the nearby railroad crossing was without a watchman after midnight, the proprietor determined to go himself. Upon ringing the doorbell as requested, a dime and a stamped letter were thrust into his hand with the request, "Here, boy, mail this, and then go back to the garage." On the return trip the garage man had ample opportunity to reflect on the cost to him of the kilowatt-hours consumed, re-washing of the car, and the time of one man, incidental to the mailing of that letter. Another woman who had let her car become nearly discharged drove to the garage one afternoon, bringing with her a big jug. As she could wait only a few minutes on account of social engagements, she requested that the attendant put the rest of the charge in the jug so that she could take it home with her.

Pooling of Prospective Truck Customers.—A plan for interchanging among competing electric-truck salesmen the names of prospective purchasers was proposed by Mr. J. W. McDowell, chairman of the Chicago Section of the Electric Vehicle Association, at a recent meeting of the section, and aroused some interesting discussion. Mr. McDowell declared that when one electric-truck salesman endeavors to make a truck sale to a customer, in competition with fifteen or twenty gasoline-truck salesmen, the overwhelming competion often serves to discredit the electric truck in the mind of the "prospect." The number of gasoline-car representatives in any city field is usually so many times the number of electric-vehicle salesmen that the prospective customer is likely to gain the impression that the electric car is of minor importance. Consequently the electric vehicle suffers from the outset. But if the customer in the market for a truck receives calls from a number of electric-vehicle men he is sure to acquire a more substantial regard for the battery-driven car. Mr. McDowell therefore proposed that any electric-vehicle salesman getting information of a "prospect" should not only call on the customer himself but also turn the name in to the local Electric Vehicle Association section secretary, who could distribute it to all the local firms interested. As the result of the succession of calls by electric-car representatives which would follow, the customer would be much more likely to buy an electric type of machine than if he had been confronted only with the selling arguments of the first salesman. Each succeeding visitor would present new sales arguments for the electric vehicle, reinforcing the efforts of the original representative. Mr. McDowell declared that his own experience had been that the prospective customer invariably made his selection and purchase more quickly when a number of competing salesmen were interested in the case.

Public Service Commission News

New York Commissions

The Second District commission has decided the Westchester Lighting Company cases, these being complaints of residents of White Plains, Port Chester, Tarrytown and North Tarrytown, Irvington and East Chester against the Westchester Lighting Company. The opinion is by Commissioner Martin S. Decker. The decision holds that the maximum electric rate of 15 cents per kw-hr. in the districts affected is excessive, unreasonable and unjust and that for the future the rate should not exceed 12 cents, and also that the minimum monthly rate of $1 is excessive and should be reduced to 75 cents.

As to the gas rates in these districts, the commission holds that, upon the valuation record as made, the company's income does not afford a rate of return which can be reduced by lawful order in these proceedings. But the commission strongly recommends the company to reduce its gas rate in these districts to $1.25 per 1000 cu. ft. as a general rate and establish even lower rates in the thickly settled portions of the Port Chester, White Plains and Tarrytown districts.

The company's figures of valuation for its gas and electric properties in the Port Chester, Tarrytown and White Plains districts and in East Chester were $6,800,000. The commission in determining the amount on which the company was entitled to return reduced this to $4,300,000, a reduction of $2,500,000.

The gas rate in East Chester is treated separately, and it is recommended that some material reduction be made in the East Chester gas rate. The present rates in the several districts are: Port Chester, $1.40 per 1000 cu. ft., and $1.25 for fuel; White Plains, $1.40 for both light and fuel; Tarrytown, $1.50 for light and $1.25 for fuel when prompt payment is made; East Chester, $1.50 for both light and fuel.

The commission says that the Westchester company has extended many of its gas mains out from the villages proper into thinly populated territory, comparatively speaking, thereby making unprofitable capital investment for the present and for some time in the future, and in taking all of its property together in these districts as the basis for a return there is some substantial disregard of the property and its return in the more densely populated, and therefore the better paying, parts of these districts.

The commission, without taking it into account as limiting its decision, also says it is greatly to be regretted that the company's enormous interest charges, arising out of securities having little, if any, relation to the actual property account, tend to force the company to secure every penny possible in gross earnings and limit the margin with which it might freely undertake gas-rate reductions that would place its large business in some districts upon a basis of rates whereby customers would have some greater inducement to indulge in much freer use of gas for fuel purposes and also for light. The commission also points out that gas is competitive with coal and that the impression made upon the customer by these high gas rates is doubtless continuous and becomes stronger monthly as the bills are paid.

In the electric department the commission finds that the business is profitable. The commission says there is fair reason to believe that in the reasonably near future respondent should contemplate seriously still further reduction of its maximum electric rate as applying over its whole territory, though it points out that the rates in Mount Vernon and New Rochelle are not embraced in these proceedings.

The company's operating income covering its entire territory, both for electric and gas service, was greater in 1913 than in 1909 by $71,954, but deductions from that income increased during the four years to the extent of over $314,000. With such deductions from income it had a book deficit in 1913 of $188,000, using round figures. The commission points out, however, that the great bulk of the interest charge increase during the four years results from the increase in the interest rate on New York & Westchester Lighting Company outstanding mortgage bonds of $10,000,000. The interest on these bonds has increased under the terms of the mortgage from 1½ per cent in 1908 to 4 per cent in 1914. This mortgage of $10,000,000, together with debenture bonds of $2,500,000, was placed on the prop-

erty in 1904 in carrying out a plan for transfer of the control of the property, and the commission is unable to find that such bonds represent any actual expenditure of money upon the property. These bonds and the interest thereon are guaranteed by the Consolidated Gas Company of New York, which owns all of the stock of the Westchester Lighting Company. Control of the property was deemed of great consequence to the Consolidated company since the Westchester company was in possession of franchises capable of being used in the city of New York and in adjoining Westchester County territory.

Respondent's total valuation figures for the gas and electric property in its Port Chester, Tarrytown and White Plains districts and East Chester for gas amounted to more than $6,800,000. This is cut down by the commission to something over $4,300,000, a reduction of $2,500,000. The reduction in valuation made by the commission amounts to $1,300,000 on gas and $1,167,000 on electricity.

Wisconsin Railroad Commission

The first part of the annual report of the Wisconsin Railroad Commission for the year ended June 30, 1914, has been completed.

A total of 541 electric, heating, water and gas utilities reported to the commission during the year, a gain of 120 since 1910. Of this number 278 were electric utilities. The commission heard a total of 644 cases, or an increase of 171 over the year previous. Of this number 237 were utility cases. A total of 100 formal decisions on utility cases were issued; 1840 complaints were received, an increase of 535 over the year ended June 30, 1913.

Authority was granted by the commission for the issue of $552,563,414 securities, as follows: Stock, $5,148,214; bonds, $546,047,200; equipment trust certificates, $1,280,000; gold bond certificates, $80,000; notes, $8,000.

The report notes a substantial increase in all utility business. In the electric utility business the operating revenues increased 11.29 per cent over a year ago. Gas utilities showed an increase of 5.2 per cent; heating utilities, 16.61 per cent. The new construction during the year showed an increase of 11.75 per cent for the electric utilities and 6.8 per cent for the gas utilities. The water utilities showed a decrease of 26 per cent.

Attention is called to the fact that since 1910 there has been an increase in the ratio of operating expenses to operating revenues for all utilities except electric lighting and gas. In the electric railway business the operating ratio increased from 68.9 per cent in 1910 to 72.88 per cent in 1914. The heating utilities show an increase from 79.86 per cent in 1910 to 87.68 per cent in 1914. In the case of the electric-lighting utility the ratio has remained practically constant at 65.5 with a tendency toward a decrease.

A certificate of convenience and necessity has been granted to the Milwaukee Light, Heat & Traction Company to operate a second electric utility in the town of Delafield to furnish energy for light, heat and power. It developed at the hearing that the existing plant is not able to furnish adequate service at reasonable rates.

Massachusetts Commission

The Gas and Electric Light Commission has dismissed the petition of consumers of the Boston Consolidated Gas Company for a reduction in prices, on the ground that the sliding-scale act (Chap. 422, Acts of 1906), under which the company supplies gas in Boston, was not repealed by the consolidation of laws affecting gas and electric companies embodied in Chap. 742, Acts of 1914. Under the terms of the sliding-scale act, the company's dividend rate was standardized at 7 per cent, with the allowance of an increase of 0.2 per cent in the rate for every 1 cent of reduction in the maximum net price below the standard of 90 cents per 1000 cu. ft. The petitioners claimed that the sliding-scale act was repealed by Chap. 742, Acts of 1914, on account of the inconsistency of the former with the latter. The boards holds that the Legislature of 1914 had no intention of superseding by the act above named all inconsistent provisions of special laws relating to gas and electric companies and to municipal lighting plants and, while refusing to express any opinion upon the merits of the sliding-scale plan, the reasonableness of the prices involved or the conduct of the company's affairs, it dismissed the complaint.

Personal

Mr. Richard Sachse has been appointed chief engineer of the Railroad Commission of California.

Mr. F. S. Armstrong, district superintendent at Macomb, Ill., of the Central Illinois Public Service Company, has been engaged as manager of the plant at Brookfield, Mo. Mr. Armstrong succeeds Mr. Louis D. Kelsey, who has resigned as manager of the Brookfield Light & Gas Company to accept the position in Oklahoma.

Mr. C. E. Groesbeck has been appointed vice-president and general manager of the Utah Power & Light Company, with headquarters at Salt Lake City, as successor to Mr. P. B. Sawyer, who has resigned. Mr. Groesbeck has been connected with the Electric Bond & Share Company for some time past and prior to that was about eight years in the organization of H. M. Byllesby & Company, principally with their Pacific Coast properties. He has spent the last two months in Salt Lake City familiarizing himself with the organization and operation of the company preparatory to assuming the duties of this important position.

Mr. R. L. Fitzgerald, an electrical engineer and a 1912 graduate of Purdue University, has been appointed business manager of Winnetka, Ill., a Chicago North Shore residential suburb with a population of about 5000. Under the new plan of town management just inaugurated by the local board of trustees, the manager will have full charge of municipal affairs under the supervision of the board. His appointment continues during good behavior and he is paid a salary of $2,400 per year. The town will continue to operate its 200-kw municipal electric plant. Mr. Fitzgerald has had experience in both engineering and appraisal work. He was formerly employed by a firm of consulting engineers at Madison, Wis., and by the Gary (Ind.) Light, Heat & Water Company, of which his brother, Mr. Leonard Fitzgerald, is vice-president and manager.

Mr. Kempster B. Miller, who, as announced in these columns on Dec. 5, was appointed chief engineer for the receivers of the Central Union Telephone Company, is president of the engineering corporation of McMeen & Miller, of Chicago. Mr. Miller, who is one of the best-known telephone engineers in the country, was born in Boston Aug. 14, 1870. While he was still young his parents went to Washington, where he entered the Washington High School. From high school he entered Cornell University, taking the course in electrical engineering, from which he graduated in 1893. During college vacations he was employed at the Thomson-Houston works at Lynn, Mass. For two years after his graduation Mr. Miller was employed as assistant examiner in the electrical division of the United States Patent Office at Washington, and from 1894 to 1896 he had charge of telephone patent applications. Mr. Miller, an incorrect portrait of whom was published by mistake in the Dec. 5 number, is widely known as the author of "American Telephone Practice" and also collaborated with his partner, Mr. McMeen, on the "Telephony" series of papers on telephone engineering subjects. On leaving the service of the government, Mr. Miller first took employment with the Westinghouse company, and from 1896 to 1898 he acted as chief electrician of the Western Telephone Construction Company of Chicago, later becoming engineer for the Kellogg Switchboard & Supply Company of Chicago. Mr. Miller's work for the last ten years has been chiefly in the telephone field, although more recently his practice has become more diversified, including also street-railway, lighting and hydroelectric work. He is a member of the American Institute of Electrical Engineers, the Engineers' Club of New York, the Engineers' Club of Chicago and the Union League Club of Chicago.

K. B. MILLER

Mr. Owen R. Jones, for the past twelve years chief electrician at the plant of the Youngstown (Ohio) Sheet & Tube Company, resigned recently to accept the position of electrical superintendent of the new open-hearth plant of the Youngstown Iron & Steel Company, now under construction at Lowellville. As an expression of their good will toward their former chief, the members of the electrical department of the Youngstown Sheet & Tube Company presented Mr. Jones with a gold watch, chain and charm in addition to a fountain pen. Mr. Jones, who was at one time connected with the Youngstown Gas & Electric Company, was recently elected president of the Association of Iron & Steel Electrical Engineers.

O. R. JONES

Mr. John Joseph Carty, chief engineer of the American Telephone & Telegraph Company and one of the foremost figures in telephone development in the world, was born in Cambridge, Mass., April 14, 1861. Because of difficulty with his eyesight he was obliged to forego a college training, and at the age of eighteen entered the old Boston Exchange as a telephone operator. For thirty-five years he has been connected with the Bell system, and he has worked assiduously in behalf of its growth and development. In 1887 he was placed in charge of the cable department of the Western Electric Company in the East, with headquarters in New York City. He studied cable manufacture as well as cable laying and introduced many improvements in methods. One of his engineering developments resulted in cutting the cost of cable manufacture in half. His work in this respect as well as what he did in Boston, where he designed and installed the first metallic-circuit multiple switchboard to go into regular service, afforded early proof of his ability to master any subject on which he put his mind. In each department of telephone work he found some field for improvement and then provided the improvement. A short time after he took charge of the cable department of the Western Electric Company the switchboard deparment was also intrusted to him. Under his direction were installed most of the large switchboards of that period, among which was the original Cortlandt Street multiple board. He also made a number of important improvements in switchboards, which have since become standard equipment. Mr. Carty was the first to demonstrate practically how to operate two or more telephone circuits connected directly with a common battery. About 1888 he installed for the supply of operators' telephones common-battery systems in a number of central offices. From these early experiments has grown the modern system generally employed. While his work has been that of an engineer, Mr. Carty has followed wherever the path of research has led him in his work along the line of telephone improvements. The result of his investigation into the nature of the disturbances to which telephone lines are subject was set forth in a paper entitled "A New View of Telephone Induction," which was read before the Electric Club, Nov. 21, 1889. On March 17, 1891, Mr. Carty made additional contributions to the general knowledge of this subject in a paper read before the American Institute of Electrical Engineers on "Inductive Disturbances in Telephone Circuits," in which he explained for the first time why twisting or transposing telephone wires renders them free from inductive disturbances. When the Metropolitan Telephone & Telegraph Company (now the New York Telephone Company) recognized the necessity for reorganizing its entire service Mr. Carty was called upon to undertake the task. In 1889 he reorganized all of the technical departments of the company, built up its staff and reconstructed the entire plant, converting it from overhead grounded circuits and series switchboard to metallic circuits placed underground and to the then new bridging switchboards. In carrying out this work he selected and trained a large staff of young men fresh from college, many of whom have since attained positions of prominence in the telephone field. In solving a problem presented by the New York Central Railroad Mr. Carty devised what is known as the "bridging bell," whereby any number of stations might be placed upon a line without in any way impairing the transmission of speech. This made possible the farmers' telephone. For his work on the bridging bell Mr. Carty had conferred upon him the Edward Longstreth medal of merit by the Franklin Institute. Mr. Carty's work in connection with the development of the plant of the New York Telephone Company has been most successful and far-reaching in its consequences. To a large extent what he has done for the telephone in the United States has contributed to the pre-eminent standing which the American telephone industry holds in all foreign countries. In recognition of his achievement as an engineer and in view of the service he rendered the Japanese government he was decorated by the Emperor of Japan with the Order of the Rising Sun. More recently he was created a member of the Order of the Sacred Treasure by the Emperor of Japan. As chief engineer of the American Telephone & Telegraph Company, Mr. Carty is responsible for the standardizing of methods of construction and operation of the vast plants of that company, which extends into almost every community of the United States, and through its long-distance wires into Canada and Mexico. At the meeting of the International Conference of European Telephone and Telegraph Administrations, held at Paris in September, 1910, Mr. Carty was one of the invited guests, and he represented the United States in the presentation of a splendid review of the features of manual and automatic handling of telephone circuits and connections with an explanation of the ideas upon which the great engineering plans of the corporation with which he is connected are based. Mr. Carty is a fellow of the American Institute of Electrical Engineers, a past-president of the New York Electrical Society, a member of the Franklin Institute, a member of the Society of Arts, an honorary member of the American Electro-Therapeutic Association, the Telephone Society of Philadelphia, the Telephone Society of New England and the Telephone Society of New York. He belongs to the Engineers', Electric and Railroad clubs of New York and to the Baltusrol and Casino clubs of Short Hills, N. J.

JOHN J. CARTY

Mr. Paul B. Sawyer has resigned his position as vice-president and general manager of the Utah Power & Light Company of Salt Lake City. Mr. Sawyer has held the position as general manager of this company since its organization a little over two years ago, when the Electric Bond & Share Company acquired the control of many of the electrical properties in the State of Utah and in Southern Idaho and merged them to form the Utah Power & Light Company. The task of welding together the numerous separate and dissimilar properties with their great difference in operating conditions and commercial policies and rates devolved largely upon Mr. Sawyer, and the results secured, considering the business and financial conditions which have obtained during this period, are a strong testimonial to his forcefulness and ability. He resigned to accept a position in the organization of Mr. Harrison Williams, of New York City, with offices at 60 Broadway. Mr. Sawyer was born in Lafayette, Ind., on May 8, 1879,

P. B. SAWYER

was graduated from Purdue University in 1900, and took a post-graduate course in electrical engineering at the same institution. He then entered the employ of the Des Moines (Ia.) Electric Company and worked his way up to the general managership, which he attained in 1907. On Jan. 1, 1912, Mr. Sawyer became general manager of the Union Electric Company, of Dubuque, Ia., where he had charge of the street-railway and electric-service interests. He took an active interest in the affairs of the Iowa Electrical Association for several years and in 1912 was elected to the presidency of that body. Mr. C. E. Groesbeck has been appointed to succeed him.

Obituary

Edwin H. Farr, chief electrician of the Northern Connecticut Light & Power Coampny, Thompsonville, Conn., died at his home on Dec. 24 after a long illness. He had been engaged in local central-station work for twenty-four years and was a native of Bridgeburg, Pa. For a number of years he had held the position of superintendent of fire alarms in the Thompsonville fire district.

John Jacob Myer, widely known in New England electrical circles as "Bill Myer," died suddenly on Dec. 13 of pneumonia at his apartments in Boston, Mass. Mr. Myer was born in Maryland about fifty years ago, and his early business experience included a term of service as the Texas representative of the Columbia Lamp Company. For the last nine years he had been New England sales representative of the American Circular Loom Company, with headquarters at 45 Milk Street, Boston. He was unmarried. Funeral services were held on Dec. 15 at St. Cecilia's Church, Boston.

Fred A. Nash, formerly president of the Omaha (Neb.) Electric Light & Power Company and president of the Citizens' Gas & Electric Company of Council Bluffs, died at his home in Omaha Dec. 11. Mr. Nash became president of the Thomson-Houston Electric Light Company in 1890 and in 1903 became president of the successor company, the present Omaha Electric Light & Power Company. This position he held until Oct. 20 of this year, when he resigned because of ill health. He was elected chairman of the board of directors, and the presidency of the company was given to Gen. George H. Harries, whose headquarters are at Louisville, Ky.

Charles Martin Hall, inventor of the electrolytic process for the manufacture of aluminum and vice-president of the Aluminum Company of America, died on Dec. 27 in Daytona, Fla. Mr. Hall was born in Thompson, Ohio, Dec. 6, 1863, and was graduated from Oberlin College in 1885. He became interested in the manufacture of aluminum through an old textbook which told of its commercial possibilities if the cost of manufacture could be reduced. At that time aluminum was worth about $25 per lb. He began his experiments in 1885, and a year later discovered the process which materially reduced the cost of manufacturing it and is now universally used. He began to produce aluminum in his own factory at Kensington, near Pittsburgh, later erecting larger factories at Niagara Falls. Priority was conceded to the Hall patent in 1893. Mr. Hall received the honorary degree of LL.D from Oberlin College in 1910, and the following year he was awarded the Sir William Perkin gold medal. He was a member of the University Club of New York, the University Club of Buffalo, the American Association for the Advancement of Science, the Institution of Electrical Engineers of Great Britain, the American Philosophical Society, the Franklin Institute of Philadelphia and the American Electrochemical Society. Mr. Hall made his home at Niagara Falls. He was a bachelor.

C. M. HALL

Corporate and Financial

Fort Worth Power & Light Bonds.—Harris, Forbes & Company of New York are offering first mortgage 5 per cent gold bonds of the Fort Worth (Tex.) Power & Light Company, at 94.

American Gas & Electric Bonds.—Moyer & Company, of Philadelphia, Pa., are offering at a price to yield about 6 per cent American Gas & Electric Company gold collateral trust 5 per cent bonds due Feb. 1, 2007.

Comparative Worth of Public Utility Bonds.—E. F. Hutton & Company of New York have prepared an interesting booklet on the comparative worth of public utility bonds. Public utility bonds are compared with railroad, industrial and municipal bonds.

Rockland Light & Power Bonds.—The Rockland (N. Y.) Light & Power Company has been authorized to use the proceeds from a sale of $100,000 of 5 per cent mortgage bonds approved in August, 1911, for improvements to its gas and electric service. The sale of the bonds will net $93,000.

Sidney Electric Authorized to Issue Securities.—The Public Utilities Commission of Ohio has authorized the Sidney Electric Company to issue $42,500 common stock and $60,000 of 6 per cent mortgage bonds at not less than 85. The proceeds are to be used for the acquisition of the Sidney Electric Light Company.

Washington Water Power Dividend Reduced.—A quarterly dividend of 1½ per cent has been declared on the stock of the Washington Water Power Company, Spokane, Wash., payable on Jan. 2, 1915. The quarterly dividends from April, 1911, to July, 1914, inclusive were 2 per cent and the dividend last October was 1¾ per cent.

Western States Gas & Electric Notes.—William P. Bonbright & Company, of New York, and H. M. Byllesby & Company of Chicago are offering $588,500 of three-year 6 per cent coupon notes of the Western States Gas & Electric Company of California at 97¼ and interest. The proceeds will be used to retire floating debt and for additional extensions.

Texas Power & Light Bond Offering.—Harris, Forbes & Company of New York are offering at 91 Texas Power & Light Company first mortgage 5 per cent gold bonds. The mortgage provides for a sinking fund of the following amounts: 1915 to 1917 inclusive, 1 per cent of the bonds outstanding; 1918 to 1920 inclusive, 1½ per cent, and 1921 to 1936, 2 per cent.

Hannawa Falls Water-Power Authorized to Issue Bonds.—The New York Public Service Commission, Second District, has approved an issue of the 5 per cent first and refunding mortgage collateral trust thirty-year gold bonds of the Hannawa Falls Water Power Company used for the purchase of machinery and equipment. The bonds are to be sold at not less than 80 and should net $44,880.

Midland Counties Public Service Corporation to Renew Notes.—The California Railroad Commission has issued a supplemental order authorizing the Midland Counties Public Service Corporation to renew two notes held by the United States Aluminum Company for $78,000 at not to exceed 7 per cent interest. The company was previously given permission to renew these notes at 6 per cent.

Tulare County Power Reduced Stock Liability.—By buying 1500 shares of its common stock which had been delinquent in assessment payment, the Tulare County (Cal.) Power Company has reduced its stock liability to approximately $400,000. The fixed capital of the company as passed upon by the California Commission is now $767,579. An issue of $1,000,000 bonds has been authorized, and when financial conditions improve $500,000 will be sold. The proceeds from this sale will be used for the payment of current obligations, for extensions and improvements.

United Illuminating New Financing.—The United Illuminating Company of New Haven, Conn., is offering to stockholders of record on Dec. 14, 1914, the right to subscribe for 6000 shares of stock at par, at the rate of one new share for every three and one-half now held by them. The right to subscribe will expire at the close of business on Jan. 15, 1915. Payment is to be as follows: $20 per share on Feb. 15, June 15 and Oct. 15, 1915, and April 15 and Oct. 15, 1916.

The new stock is to participate in dividends on Jan. 15, 1917, and thereafter.

New England Power Note Offering.—Baker, Ayling & Company of Boston, Mass., are offering $600,000 New England Power Company's 6 per cent guaranteed gold coupon three-year notes, dated Nov. 1, 1914, and due Nov. 1, 1917. These notes are part of an authorized issue of $700,000, and the proceeds will be used to reimburse the company for improvements, additions and extensions and also for the acquirement of 6 per cent notes of allied companies, with which the company is closely affiliated in the generation and distribution of electrical energy. The notes are being offered at 97⅜ and interest.

Valley Power Company Bonds.—L. H. Cook & Company, of New York, have underwritten and are offering for sale $200,000 of Valley Power Company 6 per cent first mortgage sinking-fund gold bonds at 87 and interest. The company owns a hydroelectric plant on the Shenandoah River, Virginia, and expects to be able to install machinery within a month or two after the frost is over. The company has many contracts in this region, which contains large copper mines, hardwood forests and large quarries. The capital stock of the company is $100,000, and it is owned by Mr. E. J. Thayer, of J. E. Kerr & Company, Ltd.

International Power Assets.—The probable assets of the International Power Company of New Jersey were given as $200,000 in an involuntary petition in bankruptcy filed against the company in the United States District Court. The creditor is Mr. Alfred M. Hoadley, on an assigned claim by Mr. Joseph H. Hoadley, formerly president of the company, for $55,465. On Dec. 11 Mr. Wilbur F. Sadler, Jr., was appointed receiver in equity. Notwithstanding that an appeal has been taken to the Court of Appeals against the appointment of a receiver, Chancellor Walker has issued an order permitting the receiver to continue winding up the affairs except as to the sale of the company's properties.

East St. Louis & Suburban Note Issue.—Smith, Moore & Company, St. Louis, Mo., are offering $450,000 East St. Louis (Ill.) & Suburban Company's one-year 6 per cent collateral gold notes, dated Dec. 15, 1914, at 100 and interest. The proceeds will reimburse the company for money advanced to the East St. Louis (Ill.) Light & Power Company and spent by it in the construction of a large power house on the Mississippi River just above Alton, Ill., and a high-tension transmission line from that point to East St. Louis. The growing demand for electricity has necessitated the purchase of energy generated at Keokuk. The notes are secured by the deposit of $600,000 East St. Louis Light & Power Company first mortgage 5 per cent gold bonds.

Interstate Public Service Corporation Purchases Properties.—The Interstate Public Service Corporation of Delaware has recently purchased the electric light and power properties at Kane, Pa., Johnsonburg, Pa., and Ridgway, Pa. Mr. J. G. Kaelber, president of the company, states that negotiations are pending for the acquisition of several other properties. The total capital stock as authorized is $2,000,000, of which $1,500,00 is common stock and $500,000 preferred stock. Only $750,000 of the common stock is authorized to be issued at this time. The officers of the company are Messrs. J. George Kaelber, president; Charles W. Smith, vice-president; F. W. Zoller, treasurer, and Carl F. W. Kaelber, secretary. In addition to the officers, Messrs. T. J. Swanton of Rochester, N. Y., and Selyn S. Blake of Providence, R. I., are members of the board of directors.

Nevada-California Electric Corporation.—Mr. Delos A. Chappell, president of the Nevada-California Power Company, writes that "The Nevada-California Electric Corporation, whose charter was filed recently in Delaware, is an organization primarily for the purpose of refinancing the following companies: The Nevada-California Power Company of Denver, Col.; the Southern Sierras Power Company of Denver, Col.; the Corona (Cal.) Gas & Electric Light Company, Bishop (Cal.) Light & Power Company, Hillside Water Company, and Interstate Telegraph Company. Eventually all of the bonds and all of the stocks of all of these companies will be sold to the Nevada-California Electric Corporation, which in turn will issue its first lien obligations, with all of the underlying bonds and stocks of these companies as security. Only a small portion of the holding company's bonds will be offered for sale during the coming year."

Westinghouse Companies to Be Merged.—Stockholders of the Westinghouse Machine Company have been notified that they may exchange their holdings until Jan. 26, 1915, for stock of the Westinghouse Electric & Manufacuring Company on the basis of three shares of the machine company's stock for one share of the electric company stock. The step was brought about by Messrs. Charles H. Terry, Walter D. Uptegraff and H. Herman Westinghouse, executors of the estate of the late George Westinghouse, who offered their holdings in the machine company to the electric company on the basis stated, provided that the other stockholders should receive the same permission. The executors of the Westinghouse estate took this step because the business of the machine company could not be carried on profitably without a substantial amount of additional capital, which it has been impracticable to procure under present financial conditions and the large mortgage debt of the company. The outstanding stock of the machine company amounts to $7,500,000, which if all exchanged would increase the outstanding stock of the electric company from $36,700,000 to $39,200,000. The outstanding funded debt of the machine company is approximately equal to its outstanding stock.

German Company's Ante-Bellum Report.—The annual report of the Allgemeine Elektricitäts Gesellschaft covering the year ended June 30, 1914, states that, despite the depressing conditions that existed for some time previous to the war, the company did a larger business than in the previous year. On account of the war, however, the business of the company has already been seriously affected, and in some foreign countries almost entirely destroyed—especially Argentina, Mexico and South Africa. In view of the foregoing considerations, the directors decided that out of the net earnings of $4,723,160 there should be paid a dividend of only 10 per cent on the capitalization of $38,750,000. The output in machinery and transformers comprised 123,162 pieces with a combined rating of 1,840,273 kw. This compared with 122,456 pieces and 1,973,987 kw for the previous year. The rated capacity of turbines increased from 569,908 kw to 564,033 kw, the largest unit having a 22,500-kva capacity. The business in aeroplane and searchlamp apparatus was exceptionally good. The company found it necessary to install more equipment for the manufacture of its insulating material. Progress is also reported in the manufacture of the half-watt lamp, especially in smaller sizes. The company's business in self-propelled cars is now devoted almost exclusively to military vehicles. Among the contracts in hand are transmission lines for 50,000 volts, 80,000 volts and even 100,000 volts.

New Company's Bond Offer.—N. M. Seabrease & Company of Philadelphia, Pa., are offering $400,000 Logan County Light & Power Company first mortgage 6 per cent sinking fund gold bonds. The company, which was incorporated recently in West Virginia, to supply energy to coal mines in Logan County, has already contracts for over 6000 hp. It has also taken over the property of the Logan Light Company and will supply energy to a population estimated at 28,000. The authorized capitalization of the new company is $3,500,000, of which $1,650,000 is non-outstanding, including the present bond issue; $100,000 additional bonds are held in the treasury and can be issued when needed only after the plant is completed and in successful operation. The remaining $1,500,000 bonds can be issued only at 85 per cent of the actual cost of necessary additions and extensions when the net earnings for the preceding twelve months have been at least one and one-half times the fixed charges on bonds issued and to be issued. Seven per cent preferred stock to the amount of $2,500,000 which becomes cumulative after Sept. 1, 1915, has been sold for cash. From Nov. 1, 1917, to Nov. 1, 1925, a sinking fund will be maintained equal to 1½ per cent of the outstanding bonds, and from Nov. 1, 1925, to Nov. 1, 1934, the amount will be 2 per cent. All bonds purchased or drawn for the sinking fund will be kept alive for the benefit of the fund. This is in addition to a reserve fund of 2 per cent of the gross income per annum commencing Oct. 1, 1915, kept separate from reserve and depreciation charges and available only for emergencies. The General Utilities & Operating Company of Baltimore, Md., which controls the Logan County Light & Power Company through ownership of common stock, has agreed that the plant should be in successful operation by Nov. 1, 1915.

Manufacturing and Industrial

Ernest J. Andrews, Chicago, Ill., patent attorney, has changed his address from 539 Monadnock Block to 1515 Monadnock Block.

C. G. Robin, 48 Warren Street, New York, dealer in electrical specialties, is the name of the firm formerly known as Charles G. Robinowitch.

The Electric Tachometer Company, Philadelphia, Pa., has transferred its offices from Board and Spring Garden Streets to the Perry Building. The factory of the company is at 435 North Broad Street.

The Keystone Electrical Instrument Company, Philadelphia, Pa., has changed its address from Ninth Street and Montgomery Avenue to Wayne Avenue and Windrim Avenue.

The Riley Electric Company, Kansas City, Mo., has opened offices at 503 Midland Building. F. H. M. Riley, formerly with the Kansas City Electric Light Company, is the founder of the company.

Mr. E. E. Wallace, for the past five years in charge of the electric division of the service department, New England district, General Vehicle Company, has been promoted to a position in the sales department.

The American Manufacturers' Agency, Inc., 111 West Monroe Street, Chicago, of which William H. McKinlock is president, has taken the agency for the Burnley Battery & Manufacturing Company, Northeast, Pa., manufacturer of soldering salts, sticks and paste.

Tool-Manufacturing Business Picking Up.—T. J. Cope, of Philadelphia, Pa., manufacturer of underground electrical construction tools, reports that during the past sixty days business has materially improved, and judging from inquiries being received he feels that the coming year is going to be a good one from every standpoint.

The Electric Supply Company, Worcester, Mass., has been formed to do a jobbing business and is connected with the C. C. Coghlin-Wilson Electric Company, which is engaged in the contracting business. The officers of the Electric Supply Company are as follows: C. C. Coghlin, president; W. R. McLoughlin, vice-president; A. W. Wilson, clerk; E. F. Coghlin, treasurer.

Electric Furnaces for Making Steel.—The United Steel Company, Canton, Ohio, manufacturer of vanadium steel for automobile parts, has installed in its plant two 6-ton electric furnaces for the making of steel. Six hours are required for a single charge and the furnaces are operated continuously. Each unit takes 1000 kw at the start of a run and 600 kw after the metal has melted. Energy is being obtained from the Canton Electric Company.

Arc-Lamp Controllers for Panama Exposition.—Eight controllers for motion-picture arc lamps have been ordered from the Speed Controller Company, 257 William Street, New York, for use at the Panama-Pacific Exposition. The controller was described in the ELECTRICAL WORLD of Oct. 24, 1914. This device has been meeting with considerable success and is being used in a number of the motion-picture theaters in New York City and vicinity. Among these are the Strand Theater, the Vitagraph Theater and the Broadway Theater.

Business in Recording Instruments Good.—The Roller-Smith Company, 203 Broadway, New York, is noting quite a demand for its recording meters. The business in its automobile instruments is especially good, and on account of the elimination of German competition the company's wireless apparatus is also faring well. The Roller-Smith Company is agent for Hartman & Braun, Frankfort, Germany, who manufacture vibrating-reed frequency meters, variation alarm systems and relays. Shipments have been irregular for obvious reasons, but an improvement in this respect is expected in the future.

The Marsden Electric Company, 57 Center Street, Rutland, Vt., recently formed, with principal office at Rutland and branch offices at Poultney, Vt., and Fair Haven, Vt., is engaged in a general wiring business and the sale of fixtures, lamps and appliances, covering the territory in and about Rutland. Mr. A. B. Marsden is president of the concern, Mr. L. C. Davis vice-president, and Mr. R. L. Marsden secretary and treasurer. Mr. A. B. Marsden has been superintendent of the Manchester Light & Power Company at Manchester, Vt., for the past ten years, and Mr. Davis has been engaged in the wiring business at Manchester for a similar period.

Manufacturer of Flexible Conduit Working Day and Night.—The Tubular Woven Fabric Company, Pawtucket, R. I., maker of a non-metallic flexible conduit called "duraduct," it is reported, is working its plant several nights a week to keep up with orders. The company is shipping the conduit in a special case, which was described in the ELECTRICAL WORLD of May 30, 1914, page 1273. This method of making shipments, it is claimed, has been very successful and has helped materially to increase the company's business. The conduit is of woven fabric, which is manufactured with looms made by the Chernack Manufacturing Company, of Pawtucket.

Wide Usage for Commutator Truing Device.—Jordan Brothers, Inc., 74 Beekman Street, New York, manufacturers of a device for truing commutators which does not necessitate the removal of the armature from the generator or motor, report a wide demand for this device. Among the companies using it are the following: The Hartford (Conn.) Electric Light Company, the Northern Ohio Traction & Light Company, Akron, Ohio; the Locomobile Company of America, Bridgeport, Conn.; the Amicable Life Insurance Company, Waco, Tex.; the Dayton (Ohio) Power & Light Company, the Tennessee Coal & Iron Railroad Company, the Long Island Railroad Company, the Pennsylvania Railroad Company, and the New York Central & Hudson River Railroad Company. Besides selling the machine, Jordan Brothers, Inc., use it to repair commutators for various companies. This repair business, especially in New York City, is quite extensive. Recently the concern trued the commutators of six motors used in one of the New York post offices.

Prepared to Make Gas Mantles on Large Scale.—As was reported in these columns some time ago, because of the cutting off of imports from Germany as a result of the European war, the gas-mantle industry has been seriously affected. Prior to Aug. 1, the Lindsay Light Company, Chicago, Ill., manufacturer of gas mantles, was importing its thorium nitrate and cerium nitrate from Germany, but since that time it has undertaken to make the above nitrates itself from monazite sand imported from Brazil. The company is also securing from China ramie or China grass, which is used in the manufacture of inverted mantles. This product was formerly degummed, spun and twisted in Germany; these processes, however, are now being performed in the United States. President C. R. Lindsay asserts that his company is prepared to make more than 15,000,000 of the 70,000,000 mantles used annually in this country. The Lindsay Light Company is also manufacturing inverted magnesia mantle rings and fire-polished air-hole glassware, which were formerly imported.

Orders for Turbine Units and Accessories.—The Westinghouse Machine Company, East Pittsburgh, Pa., has recently received a number of important contracts, among them being one for two 20,000-kw turbine units and two large surface condensers from the United Electric Light & Power Company, New York. Two large surface condensers were also recently sold to the Public Service Corporation of New Jersey, Newark, N. J. A 20,000-kw unit made by the Westinghouse company has just been installed in a station of the Pennsylvania Tunnel & Terminal Railroad Company at Long Island City, N. Y. Another turbine unit of the same rating, together with condenser equipment, will shortly be installed in the Edison Electric Illuminating Company's station at Bay Ridge, N. Y. Three 30,000-kw turbo-generator units manufactured by the Westinghouse company are now being installed for the Interborough Rapid Transit Company, New York, one of which will be ready for service in a few days. The business in medium-sized turbines and condensers is fair considering general conditions. The Westinghouse Machine Company is noting a slight improvement in the industrial situation and is expecting to see better times in the near future.

Mr. R. O. Bright, who has been appointed president of the American Rotary Valve Company, Anderson, Ind., manufacturer of Jenny type motors and stationary vacuum-cleaning machines, was formerly general sales manager of the Root & Vandervoort Engineering Company, Moline, Ill., having been appointed to that position after first serving as manager of the company's Minneapolis office. From 1902 to 1908 Mr. Bright was associated with the Racine-Sattley Company and with its predecessor, the Racine Wagon & Carriage Company, beginning with shop experience, followed by advertising and sales work. From 1906 to 1908 he acted as assistant to the sales manager of the central district.

Mr. Francis V. McGinness, sales engineer of the Edison Storage Battery Company, Orange, N. J., has been appointed assistant manager of the railway department, taking the position of Mr. William F. Bauer, who was recently made manager of the company's Chicago office. Mr. McGinness is a graduate of Columbia University's Schools of Applied Science, class of 1910, and before graduation had considerable practical experience with the New York & New Jersey Telephone Company. After a few months in the engineering department of the New York & Queens Electric Light & Power Company, Long Island City, he joined the sales force of the Edison Storage Battery Company. For the past two years he has been identified with the railway department, where he has formed many friendships with car-lighting engineers.

Riley Stoker Test in Toronto.—In a test made recently at the Scott Street steam station of the Toronto Electric Light Company, at Toronto, Can., a 554-hp Babcock & Wilcox boiler, equipped with a Riley stoker, was brought up to 354 per cent of its rating in seven minutes. The plant is used as a reserve for hydroelectric plants at Niagara Falls. The station contains four 554-hp Babcock & Wilcox boilers, each of which is equipped with a six-retort Riley self dumping underfeed stoker. Before starting the test the boiler was on a live bank, that is, the boiler pressure was just below the normal pressure of 150 lb. per sq. in., and sufficient coal was being fed to maintain this condition. The steam pressure at the start of the test was 5 lb. per sq. in. below normal. The load on the boilers was figured from the number of kilowatts recorded at the switchboard. Five minutes after the test began the output was 900 kw, which was equivalent to 95 per cent of boiler rating. A few seconds later the output was 1700 kw, which was equivalent to 201 per cent of boiler rating. At seven minutes after the stoker and fan started the output was 3000 kw, or 354 per cent of boiler rating.

Orders for Electrical Apparatus.—The following orders have recently been received by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.: The city of Buffalo, for the Massachusetts Avenue pumping station, one 125-kva motor-generator set and one 100-kw, 125-volt direct-current turbo-generator set with one switchboard; the Central New York Gas & Electric Company, for shipment to Geneva, N. Y., three 1000-kva, sixty-cycle oil-insulated, self-cooled outdoor transformers, three 165-kva, sixty-cycle, oil-insulated, self-cooled transformers, one 500-kw rotary converter, together with switchboard; the Hocking Sunday Creek Traction Company, for shipment to Nelsonville, Ohio, one 400-kw, 1200-volt rotary-converter set consisting of two machines on common bedplates, each having a rating of 200 kw, and three 135-kva oil-insulated, self-cooled transformers with one switchboard; the Steubenville & East Liverpool Railway & Light Company, for shipment to Steubenville, Ohio, one outdoor transformer substation consisting of two 1500-kva oil-insulated, water-cooled, three-phase, sixty-cycle outdoor radiator-type transformers, one set steel work and towers, and outdoor switching equipment. For the Steubenville substation of the Steubenville & East Liverpool Railway & Light Company orders have been received for three 500-kva transformers, six 24-kva, single-phase automatic induction regulators with accessories, one 500-kw, sixty-cycle six-phase rotary converter, one 550-kva, sixty-cycle, three-phase oil-insulated, self-cooled transformer, and two 330-kva, three-phase, sixty-cycle oil-insulated, self-cooled transformers with switching apparatus. For the latter company's substation at Toronto, Ohio, two 24-kva automatic induction feeder voltage regulators with accessories and one switchboard have been ordered.

New Industrial Companies

The Maximum Power Transmission Company, of Portland, Maine, has been chartered with a capital stock of $25,000 to manufacture and deal in motor cars, trucks, traction engines, etc. A. F. Jones is president, and T. L. Croteau, treasurer, both of Portland.

The Ross Electro-Therapeutic Manufacturing Company, of New York, N. Y., has been incorporated by S. B. Hunckley, C. M. Nichols and W. Ford, of New York, N. Y. The company is capitalized at $25,000 and proposes to manufacture electro-therapeutic appliances, etc.

The U-H Magneto Company, of Harrington Park, N. J., has been incorporated with a capital stock of $100,000 to manufacture magnetos, machinery, etc. The incorporators are C. Bergner, of Harrington Park; J. Scherer, of West Norwood, and E. Sandman, of New York, N. Y.

The A. W. R. Electric Manufacturing Company, of New York, N. Y., has been incorporated with a capital stock of $100,000 for the purpose of manufacturing all kinds of electrical designs. The incorporators are A. Roesener, M. Roesener, of New York, N. Y., and W. H. Bauer, of Danton, N. Y.

The Tubrim Manufacturing Company, of New York, N. Y., has been incorporated with a capital stock of $50,000 for the purpose of manufacturing hardware, electric cut-out boxes, machinery, motors, etc. The incorporators are L. B. Brodsky, D. Greenbaum, of Brooklyn, and L. R. Feine, of the Bronx.

The Engineering Products Company, of New York, N. Y., has been incorporated with a capital stock of $12,000 by G. Tiernan, R. G. Redlefsen and F. H. Parcells. The company proposes to manufacture all kinds of electrical machinery, foundry and factory supplies, etc. Beardsley, Hemmens & Taylor, 50 Wall Street, are attorneys.

The Edward S. Engel Company, of New York, N. Y., has been incorporated with a capital stock of $2,000 to manufacture metal articles and to carry on an electrical and mechanical engineering business. The incorporators are E. E. Engel W. Kerruisch and Meyer Liebman; Gettner, Simon & Asher, 299 Broadway, New York, N. Y., are attorneys.

The Storms Electric Car Company, of Detroit, Mich., has been organized with a capital stock of $5,000 for the purpose of manufacturing a low-priced electric automobile designed by William E. Storms, who is president and manager of the company. Ferdinand H. Zillisch, of Milwaukee, Wis., is vice-president, and Fred T. King is secretary and treasurer.

The Electro Chemico Corporation has filed articles of incorporation under the laws of the State of Delaware. The company is capitalized at $5,000,000 and proposes to carry on the business of purification and sterilization of water, sewage and other substances. The incorporators are W. J. Maloney, H. E. Latter and O. J. Reichard, of Wilmington, Del.

The Van Vechten Machine Company, of New York, N. Y., has been incorporated with a capital stock of $10,000 by W. Martin, George Satler and E. J. Coughlan. The company proposes to manufacture mill supplies, machinery and to do a general contracting and mechanical and electrical engineering business. Hunt, Hill & Betts, 165 Broadway, are attorneys.

The Julian-Beggs Signal Company, of Portland, Maine, has been chartered with a capital stock of $10,000,000 for the purpose of manufacturing and dealing in mechanical, electrical, pneumatic, automatic or any mode of signaling, train-controlling and safety appliances for railroads. A. F. Jones is president of the company and T. L. Croteau is treasurer, both of Portland.

The Kentucky Revivo Battery Company, of Louisville, Ky., was recently organized with a capital stock of $200,000 and will manufacture the "Revivo" battery under license of the Cook Railway Signal Company of Denver, Col. The company intends to distribute its products in Indiana, Kentucky, Tennessee, Alabama, Georgia, North Carolina, South Carolina, Mississippi, Louisiana, Arkansas and Florida. R. M. Kelly, Jr., is president of the company, O. M. Billings vice-president and J. T. Guthright secretary and treasurer. The directorate includes the three above officers and J. C. Paker and C. H. Parker.

Trade Publications

Toaster Stove.—"Triangle Lektrik Toaster Stove" is the title of a folder sent out by the Western Electric Company, New York.

Boiler-Tube Cleaners.—The Lagonda Manufacturing Company, Springfield, Ohio, has recently issued a bulletin entitled "Lagonda Boiler Tube Cleaners."

Insulating Joints.—The Yost Electric Manufacturing Company, Toledo, Ohio, has prepared a booklet which describes several types of insulating joints.

Electric Washer.—The Grinnell Washing Machine Company, Grinnell, Ia., is sending out a folder which describes and illustrates some of its latest types of washers.

Automobile Signal Lamp.—The Auto Signalite Company, 735 Seventh Avenue, New York, has issued a booklet describing its combination tail-lamp and signal lamp.

Historical Outline.—"Thirty Years of Progress" is the subject of an attractively illustrated book being sent out by Pawling & Harnischfeger Company, Milwaukee, Wis.

Nitrogen-Filled Automobile Lamps.—Bulletin No. 5, issued by the H. J. Jaeger Company, Hoboken, N. J., contains information on a nitrogen-filled automobile headlamp.

Electric Crane Trolley.—The Northern Engineering Works, Detroit, Mich., are sending out an illustrated folder which contains information on its type "E" electric crane trolley.

Hair Drier.—Bulletin No. 12-C issued by the Victor Electric Company, Jackson Boulevard and Robey Street, Chicago, Ill., contains information on an electrically operated hair drier.

Portable Electric Drills.—The Standard Electric Tool Company, Cincinnati, Ohio, has recently issued a folder which describes and illustrates several types of electrically operated drills.

Rectifier for Motion-Picture Service.—"For Better Projection" is the title of Folder No. 4205-A, which describes the Westinghouse-Cooper Hewitt rectifiers for moving-picture service.

Cranes.—Bulletins No. 500, No. 503, No. 504, No. 505, No. 506, recently issued by Maris Brothers, Philadelphia, Pa., contain information on electrically operated and hand-operated cranes.

Electric Stoves.—The Standard Electric Stove Company, Toledo, Ohio, is sending out an illustrated catalog containing illustrations and descriptions of electric ranges and other cooking equipment.

Color-Matching Outfit.—Apparatus consisting of a conical hood, a colored-glass screen and an arc lamp is described in a folder being sent out by the General Electric Company, Schenectady, N. Y.

Watt-Hour Meters.—Folder No. 4292, published by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., contains information on and illustrations of watt-hour meters.

Large-Sized Electric Washer.—The Henrici Laundry Machinery Company, Boston, Mass., has published a folder which describes its electric washer designed for use in laundries and hotels.

Automobile Lighting Generator.—The Carlton Company, 170 Summer Street, Boston, Mass., has issued a leaflet describing its No. 68 generator equipped with "porcupine drive," as it is called.

Motor-Generator Sets.—Bulletin No. 1090 issued by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., contains information on and illustrations of various types of motor-generator sets.

Lightning Arresters.—Bulletin No. 45,602 sent out by the General Electric Company, Schenectady, N. Y., contains information on and illustrations of lightning arresters for series-lighting circuits.

Attachment for Pull Sockets.—The Empire Engineering & Supply Company, 227 Fulton Street, New York, has published a leaflet containing information on a pull-socket attachment which lifts the chain and takes the strain off the socket.

Lighting Fixtures.—Bulletin No. 23 sent out by the Faries Manufacturing Company, Decatur, Ill., lists a number of fixtures for nitrogen-filled lamps.

Time Switches.—The Empire Engineering & Supply Company, 227 Fulton Street, New York, has issued a bulletin descriptive of its automatic time switches.

Battery Lamp Attachment.—The Burchwell Manufacturing Company, St. Louis, Mo., has issued a leaflet which describes a lamp which can be fastened to an ordinary dry cell.

High-Frequency Generators.—The Eastern Electric Company, 21 Pine Street, San Francisco, Cal., has issued a booklet which describes and illustrates several types of high-frequency machines.

Electrical Devices for Automobiles.—The Interstate Electric Company, New Orleans, La., is sending out a booklet which contains descriptions of an electric steer warmer and an electrically heated manifold plug.

Electric Mine Lamp.—The Hirsch Electric Mine Lamp Company, 314 North Twelfth Street, Philadelphia, Pa., has published several folders which describe and illustrate its miner's "safety" lamp and hand lamp.

Alternating-Current Motors.—Pocket Catalog No. 11, published by the Advance Electric Company, St. Louis, Mo., contains information on alternating-current motors varying in rating from 0.125 hp to 7.5 hp.

Electric Water Heater.—"Boiling Hot Water Instantly" is the subject of a leaflet recently issued by the Mosteller Novelty Company, 229 West Illinois Street, Chicago, Ill., which contains information on an electric water heater.

Small Motors.—A folder designated as No. 21 and entitled "The Advantages of Westinghouse Electric Small Motors" has just been issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Electric Trucks.—"Truck Talk" is the subject of Catalog No. 5, recently issued by the General Motors Truck Company, Pontiac, Mich, which contains information on a number of different types of electrically operated trucks.

Conduit Boxes and Fittings.—Pamphlet No. 442, issued by the Sprague Electric Works of the General Electric Company, 527 West Thirty-fourth Street, contains information on various types of conduit boxes and accessory fittings.

Transportation with Electric Vehicles.—"Efficient Motor Transportation with G.V. Electrics" is the title of an attractively illustrated thirty-two-page catalog recently published by the General Vehicle Company, Long Island City, New York.

Bakers' and Confectioners' Machinery.—"Motor-Driven Bakers' and Confectioners' Machinery" is the title of Catalog 3002-A, Section 3141, recently published by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Instrument Manufacturers' Plant.—The Brown Instrument Company and the Keystone Electrical Instrument Company, Philadelphia, Pa., have recently issued a folder containing illustrations of their new plant at Wayne Junction, Philadelphia.

Electric Automobiles.—"Through Sixty Years" is the subject of an attractively illustrated catalog issued by the Rauch & Lang Carriage Company, 2180 West Twenty-fifth Street, Cleveland, Ohio, which contains information on several electrically operated passenger cars.

Electrical Apparatus.—The Western Electric Company, New York, has recently issued folders which contain information on adjustable telephone brackets, "emeralite" reading lamps, "all nite lite" miniature transformers, two-ball, lamp-cord adjusters and enameled sheet-steel cut-out boxes.

Electrical Apparatus.—The following publications have recently been issued by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.: Leaflet No. 2485-A, on low-pressure turbines; Leaflet No. 3523, on a commutating-pole motor designated as No. 328; Leaflet No. 3519-A, on direct-current motors for group drive of sewing machines; Leaflet No. 3781, on large slip-ring induction motors; Leaflet No. 3707, on direct-current motors for driving job printing presses, and Leaflet No. 3783, on lightning protection for cars.

Construction News

New England

BANGOR, MAINE.—Contracts have been awarded by the Water Board for two vertical 125-hp turbine waterwheels and a generator, to be installed at the pumping station. The S. Morgan Smith Co., of York, Pa., was awarded the contract for turbines and the General Electric Co. will furnish the electrical equipment, including generator, switchboard, wiring, etc.

BROOKFIELD, CONN.—A movement has been started to secure electrical service for Brookfield. It is proposed to ask the New Milford El. Lt. Co. to extend its transmission lines to furnish electricity here.

Middle Atlantic

ROCHESTER, N. Y.—The Interstate Pub. Ser. Corpn, Granite Building, Rochester, has recently purchased the electric properties in Kane, Pa., Johnsonburg, Pa., and Ridgway, Pa., and negotiations are pending for the acquisition of several other properties. The corporation contemplates large extensions to the plants as soon as the weather permits, including the erection of transmission lines, etc. J. George Kaelber is president and Charles W. Smith is vice-president and treasurer, both of Rochester.

UTICA, N. Y.—The Public Service Commission has granted the Utica Gas & El. Co. permission to issue $500,000 in bonds, to be sold at not less than 90, to provide for extensions and improvements.

YORKTOWN HEIGHTS, N. Y.—Bids will be received by William B. Osgood Field, president of the board of managers of the New York State Training School for Boys, No. 2 West Forty-fifth Street, New York, until Jan. 12 for construction, heating, plumbing and electric work for seven cottages; for construction work of power house and coal pocket (this does not include boiler plant, plumbing or electric work) and for water supply system for the New State Training School for Boys, Yorktown Heights. Drawings and specifications may be consulted at the New York office of the Department of Architecture, Room 1224, Woolworth Building, and at the Department of Architecture, Capitol, Albany. Drawings and specifications and blank forms of proposals may be obtained at the Department of Architecture, Capitol, Albany, for which a deposit of $10 will be required, to be refunded upon return of same.

FRANCONIA, PA.—Application has been made to Governor Tener by H. R. Fehr, Charles N. Wagner and A. H. S. Cantlin for a charter for a corporation to be known as the Franconia Township El. Lt. & Pwr. Co. to supply electricity for lamps, heaters and motors in the township of Franconia.

GETTYSBURG, PA.—In reply to a question raised by the Gettysburg Ltg. Co. against the proposal of the town of Gettysburg to light its own streets, the Public Service Commission has handed down a decision that a municipality has the right to construct and operate an electric-light plant without consulting the commission.

HARMONY, PA.—The Public Service Commission has approved the contract of the Harmony El. Co., of Harmony, for supplying electricity for lighting the streets of Koppel.

IRWIN, PA.—The entire plant of the Penn El. & Mfg. Co., of Irwin, was destroyed by fire on Dec. 24, causing a loss of about $40,000. D. M. Wagoner, of Irwin, is one of the owners of the plant.

LANSFORD, PA.—The Panther Valley Lt., Ht. & Pwr. Co., of Lansford, has awarded a contract for the construction of a substation (to cost $10,000) to Andrew Breslin, of Summit Hill.

CAMDEN, N. J.—The Victor Talking Machine Co., it is reported, has asked for bids for the erection of a power plant, to cost about $150,000. The new building will be situated on Cooper Street near Front Street. Ballinger & Perrot, of Philadelphia, are architects and engineers.

NEWTON, N. J.—The State Board of Public Utilities Commissioners has issued an order authorizing the Newton Gas & El. Co. to make certain improvements to its plant.

PATERSON, N. J.—Plans are being considered by Mayor Robert H. Fordyce for the installation of an electric-lighting plant in the destructor plant to supply electricity for lighting the streets of the city.

WILMINGTON, DEL.—A committee, consisting of Councilman Weller E. Stover, chairman, and Messrs. Kane and Draper, has been appointed by the Council to confer with the Board of Water Commissioners relative to installing machinery whereby the water-power of Brandywine Creek could be utilized to generate electricity for the new municipal and county building.

GLASGOW, VA.—Bids will be received by the city of Glasgow until Jan. 29 for sale of franchise to construct and operate an electric-light and power plant in Glasgow.

RICHMOND, VA.—The Administrative Board has adopted a resolution authorizing E. W. Trafford, superintendent of the municipal electric-light plant, to make investigations as to the feasibility of supplying electricity for lamps and motors to the general public from the municipal electric-light plant.

WASHINGTON, D. C.—Bids will be received at the office of the chief signal officer, War Department, Washington, D. C., until Jan. 4 for furnishing the Signal Corps with 10,000 ft. paper-insulated aerial cable, type 401, in 1000-ft. reels, specifications 197-C and 334-C. For further information address Charles S. Wallace, captain Signal Corps, United States Army.

WASHINGTON, D. C.—Foreign trade opportunities as announced by the Bureau of Foreign and Domestic Commerce in the Daily Consular and Trade Reports: No. 14,871—A representative of public garages in a Canadian city has informed an American consular officer that the local authorities intend to require taxicabs to use taximeters, and that he desires to communicate with manufacturers of or dealers in taximeters. No. 14,872—An American consular officer in Europe reports that a company in his district has filed an application for a franchise to build an electric tramway. The railway is to be 31 miles in length. No. 14,876—An American consular officer in Asia Minor reports that a commission in his district desires to place orders for electrical supplies of all kinds, including electric lamps and bulbs, electric motors and dynamos, oil and water pumps, horizontal and vertical Diesel engines, gas pipes and high-pressure pipes. It is explained that the firm does not require credit and wishes to establish relations with manufacturers of the highest-class goods. Correspondence should be in Russian, German or French, and prices should be c.i.f. destination. No. 14,885—A manufacturer in Russia informs an American consular officer that he is desirous of importing brass tubes, brass sockets for electric incandescent lamps and wolfram filament for same and scythes. Catalogs, price lists and discount sheets are desired. Prices should be c.i.f. destination if possible. Correspondence should be in Russian or German. No. 14,899—A consul reports that an importing firm is desirous of purchasing arc-lamp globes, electric cables and electric-light accessories. Illustrations of arc-lamp globes desired accompanied the report and may be examined at the Bureau of Foreign and Domestic Commerce and its branch offices. No. 14,895—A firm in Europe has asked an American consular officer to put it in touch with American manufacturers and exporters of machinery of all kinds. References are given. Correspondence should be in Italian or French. No. 14,889—An American consular officer in Asia Minor reports the names and addresses of dealers in his district who are in the market for electric household appliances, such as fans, irons, heaters, table and hanging lamps, brackets, bulbs, wire, sockets, etc. No. 14,891—An American consular officer in Italy advises that a firm in his district desires to receive catalogs, etc., from American manufacturers of service, combustion, pressure and temperature recorders and other like devices. Correspondence may be in English. No. 14,804—A commission firm in Russia informs an American consular officer that it desires to establish direct relations with American manufacturers of hardware, tools and implements, petroleum kitchen and heating stoves and electrical supplies and lamps. Correspondence should be in Russian, French or German. No. 14,812—The manager of a municipal electric plant in Europe desires to be placed in communication with manufacturers of electrical supplies and fittings, including lamps. Further information may be obtained on application to the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., or to the following branch offices: Room 409, United States Custom House, New York, N. Y.; 629 Federal Building, Chicago, Ill.; Association of Commerce Building, New Orleans, La.; 310 United States Custom House, San Francisco, Cal.; 521 Post Office Building, Atlanta, Ga.; 1207 Alaska Building, Seattle, Wash., and 752 Oliver Building, Boston, Mass.

North Central

DETROIT, MICH.—The general contract for the construction of three substations for the Public Lighting Commission has been awarded to Corrick Brothers.

FREMONT, MICH.—A special election will be held Jan. 4 to submit to the voters the proposal of selling the municipal distribution system of $13,000 to the Grand Rapids-Muskegon Pwr. Co. and granting the company a lighting franchise.

JACKSON, MICH.—The present arc-lamp lighting system in the business district will be replaced with ornamental lamps. The city will own the lamps but will secure electricity to maintain them from the Commonwealth Pwr. Co. The contract is for a period of three years, beginning Jan. 1.

RED JACKET, MICH.—The installation of an ornamental street-lighting system in the business district is under consideration. The Houghton County El. Lt. Co. furnishes the street-lighting service here.

BUCYRUS, OHIO.—Plans are being prepared by the Bucyrus Lt. & Pwr. Co. for doubling the output of its plant in the spring. The company also contemplates extensions to its rural transmission lines.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, Room 511, City Hall, Cleveland, until Jan. 7 for piping power house and tunnel at the City Hospital, in accordance with specifications which may be obtained at the office of the secretary to the director of public welfare, Room 209, City Hall.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, Room 511, City Hall, Cleveland, until Jan. 8 for electric-light poles, paper-insulated, lead-covered cable and service switches for the municipal electric-light department, in accordance with specifications which may be obtained at the office of the commissioner of light and heat division, 1443 East Third Street. A. R. Callow is commissioner of purchases and supplies.

HILLSBORO, OHIO—The proposal of the Hillsboro Lt. & Fuel Co. for street lighting has been rejected by the voters. Plans are now being considered by the Council for lighting the town, one of which is the installation of new fixtures. A municipal plant has also been suggested.

LIMA, OHIO.—The merchants on West Market Street have submitted a proposal to the City Council offering to install an ornamental lighting system on that thoroughfare, provided that the city will pay for electricity to maintain the lamps. The plans provide for 43 standards carrying five-lamp clusters.

YOUNGSTOWN, OHIO.—Work, it is understood, will start immediately on the construction of the new electric light, heat and power plant of the Mahoning County Lt. Co. The company was recently granted permission by the State Utilities Commission to issue $600,000 in bonds, to be sold at not less than 90, and $400,000 in capital stock at par. Harry Engle is secretary and treasurer.

GARY, IND.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 15, for the construction, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office at Gary, Ind. Drawings and specifications may be obtained from the above office or from the custodian of site at Gary. O Wenderoth is supervising architect.

MONTPELIER, IND.—The Public Service Commission has granted the Montpelier Utilities Co. permission to issue $28,500 in bonds. John P. Boyd is manager.

TERRE HAUTE, IND.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 22, for repairs to plumbing, a conduit and wiring system, lighting fixtures, etc., at the United States post office at Terre Haute, Ind. For details see proposal columns.

ELGIN, ILL.—The proposal to issue $125,000 in bonds for the installation of a municipal electric-light plant, it is reported, will be submitted to the voters.

LEWISTOWN, ILL.—The property of the Lewistown El. Co. has been bought by W. H. Parlin, of Canton, Ill. A transmission line is now being erected from the station in Lewistown to a point 3½ miles east to serve the farmers along the line. C. D. Ingersoll is general manager.

STERLING, ILL.—The Illinois Northern Utilities Co., of Dixon, has accepted the ordinance recently passed by the City Council granting the company permission to erect its high-tension transmission line through Sterling.

DELAFIELD, WIS.—The Wisconsin Railroad Commission has granted the Mil-

waukee Lt., Ht. & Trac. Co., of Milwaukee, a certificate of convenience and necessity to operate a second electric utility in the town of Delafield to furnish electricity for lamps, heaters and motors.

EAU CLAIRE, WIS.—All bids for the installation of the ornamental lighting system, it is reported, have been rejected.

LAKE GENEVA, WIS.—Bids will be received by John S. Allen, manager of the Equitable El. Lt. Co., of Geneva, it is reported, until Jan. 5 for one 150-hp steam engine and steam pipe with pipe covering.

MILWAUKEE, WIS.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 22 for the installation, complete, of an electric freight elevator in the United States appraiser's stores at Milwaukee, Wis. For details see proposal columns.

DULUTH, MINN.—At a special election to be held Jan. 19 three proposals will be submitted to the voters as follows: Referendum on ordinance appropriating $85,800 fo reconstruction of first unit of municipal plant; initiative ordinance directing city to enter into a two-year contract with the Duluth Edison Co. for 6-cent rate, and alternative ordinance providing for 4-cent rate.

ELK RIVER, MINN.—The Council, it is reported, has awarded F. D. Waterman a franchise to furnish electricity for lamps and motors in Elk River, and also a contract for street-lighting. Under the terms of the contract 50 street lamps are to be installed at once.

FARIBAULT, MINN.—The Consumers' Pwr. Co., of Faribault, has just completed a 12-mile extension of its 13,200-volt system to the village of Kenyon, where it will supply electricity to the local company for distribution throughout the village and operating a flour mill. The company is also completing an extension of its 33,000-volt transmission line (about 40 miles long), which will connect Northfield and St. Paul. This line will serve the villages of Farmington and St. Paul and other small villages along the line. B. W. Cowperthwait is manager.

GILBERT, MINN.—The installation of an ornamental street-lighting system in Gilbert is reported to be under consideration.

LAMBERTON, MINN.—The local electric plant has been purchased by R. F. Wherland, of Redwood Falls, and H. L. Wherland, of Faribault. The new owners, it is understood, will make some radical changes in the operation of the plant.

ST. PAUL, MINN.—The A. H. Stem Co., of St. Paul, has been engaged as architect for the new club house of the St. Paul Athletic Club, the cost of which is estimated at more than $500,000. H. W. Terry, consulting electrical engineer of the Stem company, will have charge of the electrical work in the proposed building.

COLLINS, IA.—The Maxwell El. Lt. & Pwr. Co., it is reported, has applied to the City Council for a franchise to supply electricity for lamps and motors in Collins.

STORM LAKE, IA.—The Storm Lake El. Lt. & Pwr. Co. has just installed a new 200-hp Murray engine and a 125-kw, three-wire generator and switchboard. Edgar E. Mack is president and manager.

BLUE SPRINGS, MO.—Plans are being considered by the Commercial Club for the installation of an ornamental street-lighting system on Main Street.

EDGERTON, MO.—The McComas Hydro-Electric Pwr. Co., of Edgerton, it is reported, contemplates the construction of a dam across Platte River and the installation of a hydroelectric power plant. It is expected that work will be started on the project early in 1915.

ST. LOUIS, MO.—In the decision handed down on Dec. 21 by Circuit Judge McQuillin the Cupples Station Lt., Ht. & Pwr. Co. is given the right to erect transmission lines in the city of St. Louis outside of the so-called underground district. The decision of the court will permit all power companies who have obtained franchises under the so-called Keyes law to become competitors of the Union El. Lt. & Pwr. Co.

SLATER, MO.—Within the next 12 months the town of Slater may possibly install a new generating unit in the municipal electric-light plant, consisting of a 275-kva generator and engine. L. E. Shepard is superintendent.

ANTLER, N. D.—The installation of an electric-light plant in Antler is under consideration.

MADISON, S. D.—The City Council has decided to make extensive improvements to the municipal electric-light plant, involving an expenditure of about $20,000. A new engine and generator will be installed.

NEBRASKA CITY, NEB.—The Board of Education has adopted a resolution requiring all school buildings to be lighted by electricity.

TRENTON, NEB.—The installation of an electric-lighting system in the town of Trenton is under consideration.

CHANUTE, KAN.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 29 for the construction complete, including mechanical equipment, lighting fixtures and approaches, of the United States post office at Chanute. Drawings and specifications may be obtained at the above office or from the custodian of site at Chanute. O. Wenderoth is supervising architect.

DOWNS, KAN.—The Downs El. Lt. & Pwr. Co. is installing a series street-lighting system, consisting of 57 lamps; material for system has already been purchased. A. G. Blankensky is manager.

HORTON, KAN.—A 250-kva Allis-Chalmers generating unit (directly connected) is being installed in the municipal water and light plant. W. W. Wood is superintendent.

WINFIELD, KAN.—The City Council has authorized the Electric Light and Water Commission to advertise for bids for an additional 500-kw electric generating unit with auxiliaries. Plans and specifications will be completed within the next 30 days, at which time bids will be called for. W. J. Welfelt is superintendent.

Southern States

WHITEVILLE, N. C.—The City Council is reported to have granted a franchise to H. D. MacNair, of Maxton, to construct and operate an electric-light plant in Whiteville. Mr. MacNair was also given a contract for street lighting for a period of ten years.

WILMINGTON, N. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 14, for the construction complete, including mechanical equipment, of medical officers' quarters at the United States Marine Hospital, Wilmington, N. C. Drawings and specifications may be obtained at the above office or from the custodian of site at Wilmington. O. Wenderoth is supervising architect.

ALLENDALE, S. C.—Contracts have been awarded for the construction of an electric-light plant and water-works system in Allendale, for which bonds to the amount of $65,000 have been voted.

MACON, GA.—The Macon Ry. & Lt. Co. is planning to replace the present arc-lamp street-lighting system in East Macon with new arc lamps of 1700 cp. It is understood that equipment has been ordered.

ROCKMART, GA.—Contracts have been awarded by the City Council for new machinery for the municipal electric-light plant. The Ames Iron Works, of Oswego, N. Y., will furnish the boilers and the Allis-Chalmers Co., of Milwaukee, Wis., the generators. A 24-hour service will be established as soon as improvements are completed.

WADLEY, GA.—The contract for the construction of the municipal electric-light plant (for which bonds were recently voted) has been awarded to the Singleton-Smith Co., of Macon, Ga. S. W. Ovastreet is city clerk.

TARPON SPRINGS, FLA.—The City Council has granted H. A. and James H. Murphy a franchise to construct and operate an electric-light plant in Tarpon Springs.

KNOXVILLE, TENN.—Plans are being considered for replacing the present ornamental lighting system on Gay Street with nitrogen-filled lamps. The present street-lighting contract expires in October.

JACKSON, MISS.—An ordinance providing for an issue of $160,000 in bonds for the installation of a municipal electric-light plant has been introduced in the Council.

REDROCK, OKLA.—Plans, it is reported, have been prepared by the Benham Engineering Co., American National Bank Building, Oklahoma City, for the construction of an electric-light plant and water-works system in Bedrock. The proposal to issue $30,000 in bonds for the project will be submitted to the voters.

DALLAS, TEX.—The directors of the Dallas Tel. Co. (automatic) have appropriated $500,000 for improvements to plant, extensions of service and for additional equipment, work on which will begin at once.

DALLAS, TEX.—Extensions and improvements involving an expenditure of from $500,000 to $1,000,000, it is reported, are contemplated by the Texas Pwr. & Lt. Co., of Dallas, to its properties in Texas. The work will include the construction of a plant in Paris, to cost about $300,000 and the erection of the transmission line to supply energy to the Texas Trac. Co., at a cost of about $150,000. It is also proposed to begin work on the large plant at Waco, the cost of which is estimated at $1,000,000. The cost of the transmission line for the Texas Trac. Co. to Jenkins Station, north of Dallas, from the plant at Norwood, and the outlay for the electric plant at Paris with extensions and feeders will cost about $500,000.

ENNIS, TEX.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 25 for the construction complete, including mechanical equipment, lighting fixtures and approaches, of the United States post office at Ennis. Drawings and specifications may be obtained at the above office or from the custodian of site at Ennis. O. Wenderoth is supervising architect.

GALVESTON, TEX.—Bids will be received by the Board of City Commissioners, Galveston, until Jan. 7 for electric wiring and elevators for the new combined city hall and auditorium.

LONGVIEW, TEX.—The capital stock of the Longview Ice & Lt. Co. has been increased from $50,000 to $75,000.

UVALDE, TEX.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 22 for the construction, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office at Uvalde. Drawings and specifications may be obtained at the above office or at the office of custodian of site at Uvalde. O. Wenderoth is supervising architect.

Pacific States

TACOMA, WASH.—The City Council has authorized the installation of a new system of lamps on C and other streets, according to specifications prepared by the city engineer. The plans provide for metal standards mounted with a single lamp, to cost $17,241.

GRANT'S PASS, ORE.—The Rogue River Pub. Ser. Corpn. has submitted a proposition to the City Council to furnish energy on a wholesale basis, the city to install a distributing system and operate the same. George W. Swansor is secretary of the company.

ALHAMBRA, CAL.—A committee has been appointed by the City Council to make investigations in regard to establishing a municipal electrical distributing system in Alhambra. E. L. McCormack is a member of the committee.

ESCONDIDO, CAL.—Bids will be received by the Board of Supervisors of San Diego County until Feb. 3 for the sale of a franchise to construct and operate electric transmission lines under and over the public highways in Township 10 for a period of 50 years. Application for the franchise was made by the Escondido Wtr. Co.

FRESNO, CAL.—The City Council has adopted a single-lamp standard for the city electrolier lighting system. The standard will be either all cast iron or post with bases and tops of cast iron and shafts of pressed steel.

LONG BEACH, CAL.—The City Council has passed an ordinance authorizing the installation of ornamental (cast-iron) lamp standards on the principal business streets of the city; also providing for placing all electric wires underground in the city, the work to begin not later than July 1, 1915.

LOS ANGELES, CAL.—Surveys are being made by the Engineering Department of the route for the proposed franchise for street railway extension from North Broadway and Pritchard Street through Schuetzen Park and Hermon District to South Pasadena City limits.

MOORPARK, CAL.—Steps have been taken by the Chamber of Commerce to secure electrical service here. It is proposed to ask the Ventura County Pwr. Co., of Oxnard, to extend its transmission lines to Moorpark.

SAN DIEGO, CAL.—The City Council, it is reported, will soon ask for informal bids for installing a system of electric arches on Broadway and on Fifth Street for street illumination during exposition year.

SALT LAKE CITY, UTAH.—The contract for electric-lighting fixtures for the Newhouse Hotel has been awarded to the Salt Lake El. Sup. Co.

BILLINGS, MONT.—Work will be started on the construction of the power house (to

be located on North Broadway) of the Montana Pwr. Co. as soon as the frost is out of the ground, and the company will resume work on the erection of the high-tension transmission line, connecting with the high-tension line through the Yellowstone Valley at Park City and extending to Fromberg and Joliet.

CULBERTSON, MONT. — An electric-light plant, it is reported, will be installed in Donaldson Brothers' garage, which will supply electricity for the city.

GLASGOW, MONT.—Plans are being considered for the installation of a municipal electric-light plant during the coming year.

HOLBROOK, N. M. (not a post office).—The installation of an electric-light plant and ice factory in Holbrook is under consideration. Louis S. Frith, manager of the Gallup El. Lt. Co., Gallup, is reported to be interested in the project.

WORLAND, WYO.—Arrangements are being made by the Worland Lt. & Pwr. Co. to rebuild its plant, which was recently destroyed by fire.

SILVER CITY, N. M.—Work on the construction of a tramway from the Cleveland group of mines at Pinos Altos to Silver City, a distance of 9 miles, has been started by the Empire Zinc Co. Plans are being considered by the company to treat all the ore at its mine, using the magnetic process, energy for which will be furnished by an electric transmission line, running from Hanover, the main camp of the Empire company.

Canada

VANCOUVER, B. C.—Application has been made by the Yellowhead Lt. & Pwr. Co. to the provincial recorder at Barkerville, Cariboo District, for a license to store water for power purposes. The proposed point of diversion is approximately 3 miles from the junction of the Moose and Fraser Rivers, at the foot of the first falls. It is proposed to build four dams. The offices of the company are at 415 Winch Building, Vancouver.

PORT ARTHUR, ONT.—A by-law will be submitted to the ratepayers authorizing extensions and improvements to the municipal telephone system, to cost about $40,000.

WELLAND, ONT.—A by-law authorizing a bond issue of $5,000 for the installation of an electric fire-alarm system will be submitted to the ratepayers in January.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Jan. 7, for furnishing electric cable, wrought iron or steel pipe, coal shovels, etc. Blanks and general information relating to this circular (No. 887) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is general purchasing officer.

Directory of Electrical Associations

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, H. O. Hanson, Mobile Gas Co., Mobile, Ala.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Permanent secretary, L. O. Howard, Smithsonian Institution, Washington, D. C.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 29 West 39th St., New York.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS. Secretary, Eugene W. Stern, 101 Park Ave., New York City.

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AMERICAN PHYSICAL SOCIETY. Secretary, Prof. A. D. Cole, Ohio State University, Columbus, Ohio.

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ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, 112 West Adams St., Chicago.

CALIFORNIA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, W. S. Hanbridge, 1408 Merchants' National Bank Building, Los Angeles, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Affiliated with N. E. L. A. Secretary-treasurer, Alan Sullivan, 610 Confederation Life Bldg., Toronto, Can.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer, T. F. Kennedy, 900 15th St., Denver, Col.

COMMERCIAL SECTION, N. E. L. A. Secretary, J. F. Becker, 1170 Broadway, N. Y.

EASTERN NEW YORK SECTION, N. E. L. A. Secretary, C. S. Van Dyck, Schenectady, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF MASSACHUSETTS. Secretary, H. D. Temple, 30 Foster St., Worcester, Mass.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russel, Jr., 25 West 42d St., New York.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, A. J. Burns, 318 West Tenth St., Kansas City, Mo.

ELECTRICAL CONTRACTORS' ASSOCIATION OF WISCONSIN. Secretary, Albert Petermann, 626 Lloyd St., Milwaukee, Wis. Annual meeting, Milwaukee, Jan. 18-21.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 125 Michigan Ave., Chicago, Ill.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Meeting, San Francisco, second Thursday of each month.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA. Executive secretary, A. Jackson Marshall, 29 West 39th St., New York. Sections in New York, New England, Chicago, Philadelphia, Washington and Los Angeles.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 29 West 39th St., New York.

GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION OF OKLAHOMA. Secretary-treasurer, Prof. H. V. Bozell, Norman, Okla.

GEORGIA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, J. M. Clayton, Atlanta, Ga.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, Peoria, Ill.

ILLUMINATING ENGINEERING SOCIETY. General secretary, C. A. Littlefield, 29 West 39th St., New York.

INDEPENDENT TELEPHONE ASSOCIATION OF AMERICA. Secretary, W. S. Vivian, 19 South LaSalle St., Chicago. Annual meeting, Minneapolis, Minn., Jan. 19-21.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Thomas Donahue, Lafayette, Ind.

INDIANA STATE ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, George Skilman, Indianapolis, Ind.

INSTITUTE OF OPERATING ENGINEERS. Secretary, L. Houmiller, 29 West 39th St., New York.

INSTITUTE OF RADIO ENGINEERS. Secretary, E. J. Simon, 71 Broadway, New York.

INTERNAL COMBUSTION ENGINEERS' ASSOCIATION. President, Charles Kratsch, 416 West Indiana St., Chicago. Meeting second Friday of each month at Lewis Institute.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex.

INTERNATIONAL ENGINEERING CONGRESS. Secretary-treasurer, W. A. Cattell, Foxcroft Building, San Francisco, Cal. Congress, San Francisco, September.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England. Meeting at San Francisco, Sept. 9-11.

IOWA ELECTRICAL ASSOCIATION. Affiliated with N. E. L. A. Secretary, W. H. Thomson, Des Moines, Ia.

IOWA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, M. T. Humphrey, Waterloo, Ia.

IOWA STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, H. E. Weeks, Davenport, Ia.

JOVIAN ORDER. Jupiter (president), Homer E. Niesz, Chicago, Ill.; Mercury (secretary), E. C. Bennett, Syndicate Trust Building, St. Louis, Mo.

KANSAS GAS, WATER, ELECTRIC LIGHT AND STREET RAILWAY ASSOCIATION. Secretary-treasurer, Ivor Thomas, 237 South Main St., Wichita, Kan.

LOUISIANA ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, J. J. Ziegler, 227 Bourbon St. Meeting every Wednesday, Audubon Building, New Orleans.

MAINE ELECTRIC ASSOCIATION. Secretary-treasurer, Walter S. Wyman, Waterville, Maine.

MICHIGAN ELECTRIC ASSOCIATION. Affiliated with N. E. L. A. Secretary, Herbert Silvester, 18 Washington Boulevard, Detroit, Mich.

MINNESOTA ELECTRIC ASSOCIATION. Secretary-treasurer, F. A. Otto, St. Paul Gas Light Company, St. Paul, Minn. Annual meeting, St. Paul, March 23-25.

MISSISSIPPI ELECTRIC ASSOCIATION. Affiliated with the National Electric Light Association. Secretary-treasurer, H. F. Wheeler, Hattiesburg, Miss. Next annual meeting, Hattiesburg, April 12-14.

MISSOURI ELECTRIC, GAS, STREET RAILWAY AND WATER WORKS ASSOCIATION. Secretary-treasurer, F. D. Beardslee, Union Electric Light & Power Co., St. Louis.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, Wm. L. Smith, Concord, Mass.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive secretary, T. C. Martin, Engineering Societies Building, 33 West 39th St., New York. Annual meeting, San Francisco, June 7-11.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, George H. Duffield, 41 Martin Building, Utica, N. Y. Annual meeting, San Francisco, July 18-24.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass. Open meeting, New York, March.

NATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, J. B. Earle, Waco, Tex.

NEBRASKA SECTION, N. E. L. A. Secretary-treasurer, S. J. Bell, David City, Neb.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 60 State St., Boston, Mass.

NEW ENGLAND SECTION, ELECTRIC VEHICLE ASSOCIATION OF AMERICA. Secretary, L. L. Edgar, 39 Boylston St., Boston, Mass.

NEW ENGLAND SECTION, N. E. L. A. Secretary, Miss O. E. Bursiel, 149 Tremont St., Boston, Mass.

NEW YORK ELECTRIC RAILWAY ASSOCIATION. Secretary, Charles C. Dietz, 365 East 21st St., Brooklyn, N. Y.

NORTHWEST SECTION, N. E. L. A. Secretary, N. W. Brockett, Pioneer Building, Seattle, Wash.

NORTHERN WHITE CEDAR ASSOCIATION. Secretary, R. N. Boucher, 743 Lumber Exchange, Minneapolis, Minn.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio.

OREGON ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary-treasurer, J. W. Oberender, Portland, Ore.

PENNSYLVANIA ELECTRIC ASSOCIATION (State Section N. E. L. A.). Secretary-treasurer, H. N. Müller, Pittsburgh, Pa.

RAILWAY SIGNAL ASSOCIATION. Secretary-treasurer. C. E. Rosenberg, Times Building, Bethlehem, Pa.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. General manager, J. M. Wakeman, 29 West 39th St., New York.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa. Annual meeting, Ames Ia., June 22-25.

SOUTHEASTERN SECTION, N. E. L. A. Secretary-treasurer, Geo. H. Wygant, Tampa, Fla.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, H. S. Cooper, 405 Slaughter Building, Dallas, Tex.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, C. H. West, Rutland, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 76 West Monroe St., Chicago, Ill. Annual meeting, Minneapolis, Minn., Jan. 26-28.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, George Allison, 1410 First National Bank Building, Milwaukee, Wis. Annual meeting, Milwaukee, Jan. 18-20.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED DEC. 22, 1914.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York, N. Y.]

1,121,601. ELECTRICAL CONDUCTOR; T. B. Allen and L. B. Coulter, Niagara Falls, N. Y. App. filed Nov. 21, 1911. Silicon carbide impregnated with fine graphite.

1,121,607. HANGER FOR TROLLEY WIRES; G. H. Bolus, Mansfield, Ohio. App. filed Feb. 9, 1912. Quick, detachable, catenary type; made of sheet metal.

1,121,619. METHOD OF MAKING VALVES; R. L. Ellery, Toledo, Ohio. App. filed Feb. 10, 1914. Welding tungsten-steel valve heads to carbon-steel shanks.

1,121,625. SWIVEL ARRANGEMENT FOR ELECTRIC TERMINAL PLUGS; M. Herskovitz, Chicago, Ill. App. filed July 12, 1913. Two-part, separable swivel attachment plug.

1,121,626. MEANS FOR MEASURING THE FREQUENCY OF AN ALTERNATING CURRENT; C. E. Hiatt, East Orange, N. J. App. filed Feb. 21, 1911. Has a measuring capacity ranging from only a few cycles to hundreds of thousands per second.

1,121,635. CONTROLLER FOR HEATING SYSTEMS; F. T. Kitchen, West New Brighton, N. Y. App. filed June 7, 1913. For railway cars.

1,121,649. ELEVATOR SIGNAL; C. A. McIntyre, Philadelphia, Pa. App. filed June 11, 1913. Opening of door breaks circuits through signals previously shown.

1,121,664. PLUG; O. Prochazka, Detroit, Mich. App. filed Feb. 13, 1914. Can be quickly engaged with and positively locked in the socket.

1,121,666. AUTOMATIC TELEPHONE EXCHANGE; F. N. Reeves, Newark, N. J., and A. E. Lundell, New York, N. Y. App. filed July 5, 1912. Multi-office "satellite system."

1,121,674. RHEOSTAT-RESISTANCE CAR HEATER; J. T. Skinner, Lawrence, Kan. App. filed Feb. 7, 1914. The control resistance supplies the heat for the car.

1,121,725. ELECTROMAGNETIC BRAKE-OPERATING MECHANISM; G. E. Hindley, Park Ridge, N. J. App. filed March 19, 1913. Drawbars each connected to the armatures of a series of electromagnets.

1,121,739. TELEPHONE-TOLL-LINE SYSTEM; F. A. Lundquist, Chicago, Ill. App. filed Nov. 14, 1913. Central office is apprised of the denominations of the coins deposited by subscriber.

1,121,743. APPARATUS FOR HEATING, EVAPORATING, VOLATILIZING OR DISTILLING LIQUIDS BY ELECTRICITY; T. McClelland, Jr., Glasgow, Scotland. App. filed Nov. 30, 1912. Granular carbon in perforated container.

1,121,750. ELECTRICAL CIRCUIT-CHANGING SWITCH; T. B. Miller, Seattle, Wash. App. filed Sept. 11, 1912. Applied to tuning coil of wireless-telegraph system.

1,121,754. AUTOMOBILE LAMP SIGNAL; F. Pastor, Akron, Ohio. App. filed Jan. 26, 1914. Turning of steering wheel lights direction lamps at sides of car.

1,121,764. METHOD OF AND APPARATUS FOR RECTIFYING ELECTRIC CURRENTS; C. C. Ruprecht, Cleveland, Ohio. App. filed Feb. 6, 1908. Electrolyte cell and special electrodes.

1,121,769. FRAME FOR RHEOSTAT-RESISTANCE ELEMENTS; J. T. Skinner, Lawrence, Kan. App. filed June 16, 1914. Pressed metal with ventilating openings.

1,121,771. BATTERY; E. Sokal, Chicago, Ill. App. filed Dec. 15, 1911. Renewable primary battery.

1,121,786. MOTOR CONTROLLER; T. E. Barnum, Milwaukee, Wis. App. filed June 1, 1909. Remote control of shunt-wound motors.

1,121,792. METHOD OF COMPRESSING BAKED CARBON ARTICLES AND CLOSING LAMINATIONS AND SEAMS THEREIN; J. W. Brown, Lakewood, Ohio. App. filed June 6, 1912. Compressed and heated by the passage of an electric current.

1,121,798. DRUM-ARMATURE WINDING MACHINE; P. E. Chapman, St. Louis, Mo. App. filed March 19, 1908. Adjustable to take various sizes and styles of armatures.

1,121,802. METHOD OF COATING PROJECTOR LAMPS WITH REFLECTING SURFACES; E. L. Clark, Lakewood, Ohio. App. filed Jan. 11, 1913. Condenses a vapor of the coating material on the interior of the lamp.

1,121,823. TIME-ANNOUNCING SYSTEM; M. F. Geer, Rochester, N. Y. App. filed March 1, 1912. For railway-dispatch telephone systems.

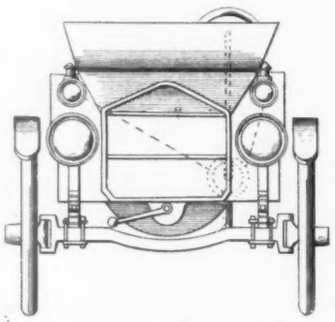
1,121,834. ELECTRICAL MEASURING APPARATUS; C. E. Hiatt, Philadelphia, Pa. App. filed May 25, 1909. Frequency meter having a thermo-junction.

1,121,835. COMPARATOR; C. E. Hiatt, Philadelphia, Pa. App. filed May 25, 1909. For comparing two electromotive forces or currents.

1,121,859. COMPOSITE MAGNETIZABLE MATERIAL; E. H. Messiter, Brooklyn, N. Y. App. filed Nov. 8, 1912. Pole piece or the like made up of a bundle of magnetizable wires brazed together.

1,121,874. ZINC FURNACE; O. E. Ruhoff, Madison, Wis. App. filed March 26, 1914. Electric; handles the cheaper ones and effects recovery of metals other than the zinc.

1,121,876. RECHARGEABLE ELECTRIC FUSE; A. Schipper, Ogden, Utah. App. filed Jan. 16, 1914. Ventilated-fuse strip clamped by the terminal screw caps.



1,121,754—Automobile Lamp Signal

1,121,877. ELECTRIC SWITCH; W. M. Scott, Radnor, Pa.; J. H. Wyatt, Philadelphia, Pa., and T. W. Greathead, Mortar, Pa. App. filed Dec. 5, 1912. Terminal has a slotted face engaged by the laminas of the movable switch member.

1,121,892. BATTERY-CHARGING SYSTEM; C. E. Beach, Binghamton, N. Y. App. filed Aug. 2, 1913. Charging time is automatically controlled.

1,121,897. RELAY; E. B. Craft, Hackensack, N. J. App. filed Sept. 23, 1913. Special mechanical features of construction.

1,121,953. TELEPHONE METERING SYSTEM; E. Thompson, Swamscott, Mass. App. filed filed Feb. 15, 1912. Records length of time a calling subscriber's instrument is in use.

1,121,960. MOLDED METALLIC ARTICLE AND METHOD OF MAKING THE SAME; W. R. Whitney, Schenectady, N. Y. App. filed Oct. 12, 1910. Brush made of copper and an incorporated lubricant containing sulphur and molybdenum.

1,121,966. ELECTRIC HEATING UNIT; H. P. Ball, Pittsfield, Mass. App. filed April 23, 1913. Metal-sheathed resistance wire brazed to the metal top plate.

1,122,979. THERMOELECTRIC REGULATOR; E. F. Collins, Schenectady, N. Y. App. filed Oct. 15, 1913. For resistance furnaces.

1,121,983. AUTOMATIC REGULATOR FOR ELECTRIC CIRCUITS; A. S. Cubitt, Schenectady, N. Y. App. filed Dec. 14, 1908. For lamps in street cars, etc.

1,121,986. SUBAQUEOUS AUDIBLE SIGNALING APPARATUS; S. M. Davison, London, Eng. App. filed April 13, 1914. Transmitter is out of high conductive connection with hull of vessel, and receiving medium consists of paraffin wax in inductive connection with the water.

1,121,996. ELECTRICAL CIRCUIT-BREAKER; E. Gassmann, Brooklyn, N. Y. App. filed Oct. 31, 1913. For ignition devices.

1,121,997. ELECTRICAL CUT-OUT; E. G. Gilson, Schenectady, N. Y. App. filed Feb. 1, 1912. Metallic plates consisting largely of lead and an interposed layer containing graphite, a metal of the tungsten group and a binder.

1,122,001. IGNITION SYSTEM FOR INTERNAL-COMBUSTION ENGINES; J. O. Heinze, Detroit, Mich. App. filed May 22, 1914. Includes an interrupter and a vibrator which can be rendered inoperative.

1,122,010. LOCK CIRCUIT-CLOSER; J. F. Lesko, Chicago, Ill. App. filed May 20, 1914. Causes alarm to be given when the lock bolts of a door are withdrawn.

1,122,011. PROCESS AND APPARATUS FOR PRODUCING ROENTGEN RAYS; J. E. Lilienfeld, Leipzig, Germany. App. filed Oct. 2, 1912. Uses a heating element.

1,122,016. PORTABLE PROTECTING APPARATUS; E. L. Maltby, Brooklyn, N. Y. App. filed Dec. 11, 1909. Burglar alarm for chest containing valuables.

1,122,019. ELECTRIC SWITCH; E. B. Merriam, Schenectady, N. Y. App. filed Aug. 15, 1912. Tendency of the arc to blow the oil away from the contacts is effectively resisted.

1,122,021. SAFETY CHEST; L. Myers, Newark, N. J. App. filed Oct. 10, 1910. Mechanism inside the chest gives alarm when chest is disturbed.

1,122,027. METHOD OF TUNING ALTERNATING-CURRENT CIRCUITS; M. Osnos, Berlin, Germany. App. filed June 6, 1913. By regulating the magnetic condition of the electrical apparatus included in the circuit.

1,122,028. TEST CONNECTOR; F. R. Parker, Chicago, Ill. App. filed Nov. 30, 1906. Clamp for independently holding one or several wires.

1,122,030. SUSPENSION-INSULATOR EYEBOLT; J. A. Sanford, Jr., East Liverpool, Ohio. App. filed Jan. 21, 1913. Has a corrugated shank secured in cement.

1,122,031. PULL SOCKET; H. F. Sargent and T. Koch, Schenectady, N. Y. App. filed July 8, 1912. Details of chain guide and spindle support.

1,122,032. THERMAL CIRCUIT-CLOSER; J. F. Scheuer, Two Rivers, Wis. App. filed Jan. 26, 1914. Fusible for electric signaling apparatus.

1,122,041. ELECTRIC BROILER; W. Stanley, Great Barrington, Mass., and H. P. Ball, Pittsfield, Mass. App. filed Nov. 4, 1912 For ranges of the heat-storage type.

1,122,045. ELECTRIC SWITCH; F. L. Temple, Cedar Grove, N. J. App. filed Oct. 24, 1911. Rotary-type; maintains one branch of the circuit closed while the switch is open.

1,122,185. VAPOR-ELECTRIC APPARATUS; C. O. Bastian, London, Eng. App. filed Dec. 9, 1905. Has a subsidiary positive electrode.

1,122,187. COIL SUPPORT; B. A. Behrend, Milwaukee, Wis. App. filed Oct. 19, 1908. Special support for the end turns of the coils.

1,122,193. ELECTRIC COUPLING; J. L. Cobb, Los Angeles, Cal. App. filed July 21, 1913. Combined with the fluid-pressure coupling of a train.

1,122,194. ELECTRODE HOLDER FOR ARC LAMPS; C. W. Drake, Chicago, Ill. App. filed Dec. 5, 1912. Electrode has fluted sides and the holder has inwardly projecting ribs engaging the ridges thereof.

1,122,213. ADJUSTABLE END HEAD FOR DYNAMO-ELECTRIC MACHINES; E. Mattman, Norwood, Ohio. App. filed Sept. 24, 1906. Eccentric bushings surrounding the securing bolts permit the necessary adjustment.